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JAPAN'S ATTITUDE TOWARD AMERICA

THREE PROBLEMS OF JAPAN AND UNITED STATES

ASPECTS OF ELECTRICAL DEVELOPMENT IN CHINA

THE CRISIS IN FUKIEN

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The Far Eastern Review

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VOL. XXIX SHANGHAI, DECEMBER, 1933 No. 12

Three Problems of Japan and United States

By TOKICHI TANAKA, Former Ambassador to the U.S.S.R. in "Contemporary Japan"

THE three potential sources of conflict between Japan and America are Manchuria, naval limitation and immigration. Each problem has its own difficulty. Yet none of these questions need trouble the peace of the United States and Japan, if common-sense and a spirit of accommodation prevails on both sides.

International lawyers differ as to whether Japan's action in the Manchurian conflagration of 1931 did or did not contravene the Anti-War Pact and the Nine-Power Treaty. I shall not attempt to discuss the juridical issues; legal interpretations are open to diverse approaches which often lead us away from the important core of the question. It is sufficient to point out that those engagements are simple in formula and cover a vast field. They are competent to dispose of sporadic and temporary disputes. But in Manchuria Japan was confronted with a long series of inimical actions in a region where she has special rights of old standing vitally concerning her economic existence and national security. Such issues could not be solved by the simple application of a general principle.

Japan's Vital Interest

Differences of opinion as to the course Japan took must now be left to the historian. No Japanese Government could reverse what has been accomplished. Because of the vital interests at stake the Japanese people are more concerned with the prospects of the new State than with past events. How, then, is Manchoukuo progressing? If we say that the people are well content with their new government, the statement will be called Japanese propaganda; but it is none the less true. The achievements of the new State, especially in establishing a sound financial basis for the economic life of the people of Manchoukuo, are already remarkable. The people of Manchoukuo are inarticulate in politics, but they see that order has been restored and the burden of taxation reduced. Security of life and property is being assured by the new government as by no other Manchurian administration within living memory, and Manchoukuo, in striking contrast to Chinese defaults, is discharging its foreign debts.

Even the Lytton Commission admitted that the old régime should not be allowed to return, and since it is impossible to undo the independence of Manchoukuo, the duty of lovers of peace is to allow reconstruction to proceed. It is unimaginable that Americans, themselves a constructive people, should interfere with the task of building up a sound state where formerly disorder and misgovernment prevailed. To permit Manchuria to rejoin China would simply mean an extension of war-lord rule, with its attendant chaos. Japan could never consent to such a course, nor can any lover of peace desire the restoration of conditions which created misery and oppression. The Manchurian situation is simple and can be clearly understood, if realities are faced and the claims of peace and humanity considered.

Many Americans advocate non-interference in China which, in their view, should be treated by the world as an organized state in spite of the obvious evidences of chaos and disintegration. In principle this attitude is above reproach, but in practice its result has been the prolongation of disorder and not the growth of stability which was hoped for. The United States and other Western Powers can afford a "laissez faire" policy in China, because their interests there are relatively inconsiderable and are not essential factors in their own existence. Japan cannot share that fortunate detachment from the fate of a nation of 400 million people at her door.

U. S. Policy Toward China

If China is to be given equal treatment with stable states, as some Americans seem to argue, the Washington Government must waive the extraterritorial and other legal privileges now enjoyed by its nationals, must withdraw its troops from Chinese territory and, contrary to past practice which necessity dictated, refrain from the use of armed force for the protection of American life and property. If America really believes in such a policy she can show her sincerity by deeds. Without such deeds arguments of the kind I have sketched will only be interpreted as attempts to checkmate Japan. For what reason should Americans assume that Japan has to be checked? Peace, order and stability in the Far East are an overwhelming interest of Japan, and a policy which promotes these conditions can injure no American interest. If Americans object to Japanese action, an alternative course is open to them. They could take an active part in assisting China to attain the political and economic stability without which its claim to be an organized state will remain a fiction. To the best of my knowledge, Americans have consistently refrained from supporting any scheme for the stabilization of China with external assistance, and yet they have criticized Japan for her national policy towards China and Manchuria. Is it too harsh to describe the American attitude as sentimentalism which, far from implying respect and real sympathy for China, looks upon that country as an underdog to be pitied and excused? America, with no great matter at stake, may continue to make China an object of unreflecting and misplaced sympathy, but Japan cannot afford to see disorder grow and spread indefinitely around her.

Japan does not repent that she signed the Washington and London naval treaties, nor will she fail in her obligations so long as those treaties are in force. She is, of course, free to make other proposals when the next naval conference meets, and this freedom was clearly announced by the Japanese delegation at the London Conference. Circumstances in the world have changed since 1930, but when the naval Powers next meet to seek a new compromise on armaments, Japan will be second to none in supporting limitation, not only to lighten burdens which a poor country can ill support, but because we believe that it is a means of lessening the incentives to war.

The first condition of arms limitation schemes is that they should not create a sense of national insecurity, and this vital factor, security, can only be determined by careful study of actual conditions. The people of a country are the only judges of its defensive requirements. All that we can do in the delicate matter of other nations' defences is to try to relieve and moderate any international factors which are likely to cause tension. The Japanese people observed with concern the manner in which the United States made common cause with the League of Nations during the Manchurian dispute. The lesson was instructive and had much to do with the demand now heard for naval parity.

Relative Naval Strength

The discussion of relative naval strengths involves many intricate technical considerations, but it is fair to assume that each nation has a just right to parity. There is nothing sacred about one ratio or another; the ratio is only an expediency. A proud nation may accept an inferior ratio rather than see an international effort fail but such ratios cannot be regarded as eternal and exempt from revision and change. A recent remark of Mr. Claude A. Swanson, United States Secretary of the Navy, is pertinent in this connection: "We have a natural right and duty" (he wrote) "to maintain a navy equal to that of any other nation." If the American right to parity is "natural," can Japan be denied an equal right? I need not dwell on Germany's demand for equality in armaments, but it is appropriate to remember that more than fifty nations, great and small, have equal votes in the League of Nations. There is nothing preposterous in the suggestion that a small number of naval Powers should enjoy the right of parity. I venture to say that the first step of the next naval conference should be the explicit recognition of this "natural right and duty" to naval equality.

Though not a naval expert, I would also suggest that commonsense can go a long way in making practical adjustments. The ratio is not really the first consideration. The object in view is reduction of burdens and prevention of war, and the shortest cut to this double objective is the abolition of all long-range weapons, I advocate the total abolition of battleships, aircraft-carriers and large submarines. Such craft, because of their range, can go far from their own shores to attack their enemy. If they are universally scrapped, national defence will not be weakened and the sense of security will not be impaired, while aggressive capacities will be greatly reduced. Since the vast Pacific Ocean divides—and protects—Japan and America, they can afford to agree with each other to abolish those categories. If it is said that the elimination of certain classes would not extinguish competition, the answer is that neither Japan nor the United States is so senseless as to spend money in building ships for mere prestige and pride. We can control naval rivalry by fixing a maximum tonnage and a maximum in the number and calibre of guns. Again, it may be pointed out that America has to guard herself in two oceans. Japan has little concern with the Atlantic and would be content to leave matters to be discussed with the United States and Great Britain. It is not necessary that Japan, America and Britain should discuss their respective fleets at the same time around the same table.

We Japanese are at a loss to know the precise reasons for which America demands a margin of naval superiority over Japan. Do Americans fear a Japanese attack on their oversea possessions, or do they think a big navy necessary to preserve the open door for trade in China? Such apprehensions appear to us fantastic. If they really exist, Japan, I am confident, will be glad to enter into such engagements with America as will finally and completely dispel them. The roads to peaceful understanding are open, and surely it behooves America to try them before she denies to Japan a "natural" right.

Problem of Immigration

The third problem, immigration, has been so extensively discussed that it calls for but little space here. The sum and substance of the Japanese demand is for the abolition of the discrimination against us which is so obvious in the Immigration Law. But even should America leave the matter as it stands, it will not lead to war. Whether America's credit and prestige and reputation for fair play would be enhanced in the eyes of the Asiatic nations by a refusal to remove the discriminatory clause, I will leave Americans to judge.

I submit with confidence that in these three issues, the only issues open between Japan and the United States, there is nothing which cannot and should not be solved by peaceful means. Economic rivalries, which nowadays are the principal source of international disputes, fortunately do not come into the field of Japanese-American relations. Nowhere on earth do our markets conflict with America's. Our trade relations are complementary and mutually beneficial—a happy condition rarely found in the world as it exists to-day. Both Japan and the United States are young nations, unencumbered by the historical feuds which cause havoc in Europe. All their circumstances favor mutual friendship and peace. Failure to use the fortunate advantages which make for the easy adjustment of their problems would be a reproach to the statesmanship of both countries.

To Americans who read this I desire to say a final word in all friendship and sincerity. The United States possesses a vast territory, rich in natural resources and in the numbers and energy of its people. In these respects Japan cannot compare with America but the greatness of a nation should not be judged by material elements only. The Japanese do not consider themselves inferior in any way to the Americans, in talents, culture or morality. What Americans have done, the Japanese believe they also can do. Japan has made great progress in recent decades, and the Japan of to-day is not the Japan of yesterday. Estimates of Japan which may have been accurate enough twenty years ago are no longer adequate. The world is on the move, and the nations which compose it are growing or decaying. Japan must be measured as she is to-day, not as she was before.

Asia Becoming Self-Conscious

Asia is different from the West, and it may be the plan of nature that the difference should persist. Asia is becoming self-conscious, and is passing through the agony of re-birth. Whatever errors Japan may make, whatever may be her limitations, it is beyond question that Japan alone among Asiatic nations has the power and the will which make her the stable element in this turbulent and changing continent. The hope of stability in Eastern Asia depends upon Japan. If America chooses to co-operate with Japan, that hope, though dim at present, will gradually grow brighter. Any policy which disregards the one strong and stable nation in Asia can only perpetuate the weakness and the insecurity which are the source of Asia's troubles now.

Mr. Woodhead's New Magazine

Of more than passing interest is the appearance in December of the new magazine, "Oriental Affairs," and this is specially noteworthy by reason of the circumstance that the new publication is edited and published by the distinguished British editor and writer, Mr. H. G. W. Woodhead, C.B.E.

As is set forth in a foreword, it is the aim of the publisher to make of the new magazine a forum for the presentation of views on current problems from all angles and to present an outline of unfolding political conditions in the Far East that will be critical and constructive. It goes without saying that such an undertaking in this vexed era of unrest could not fall into abler hands, for through many years Mr. Woodhead has lived in the shifting swirl of events in China as an intimate of many of the leading characters on the Chinese political stage. And as Editor, for considerably more than a decade, of the outstanding work of reference on China—The Chinese Year Book—aside from his extensive editorial activities, Mr. Woodhead has attained a status that is quite unique as an authority on the things he writes about.

Some significance is to be attached to an expression of the Editor in his initial number with regard to the new monthly. . . . "The underlying aim," he says, "will be the promotion of co-operation between the various nationalities interested in the Far East—co-operation in the generally accepted sense of the word, not, as it is sometimes interpreted, continuous concessions and conciliation on one side, and recalcitrance and obstruction on the other." This is a thought to which foreign residents in general in China will give hopeful assent.

Of particular interest in the first number of "Oriental Affairs" is a trenchant article on "The Fukien Revolt," concerning the outcome of which the writer ventures no prophesies. Other informative articles deal with the "Resignation of Mr. T. V. Soong," "Sino-Japanese Relations," the Shanghai problems of factory inspection and jurisdiction of "outside roads," "The Opium Problem at Geneva" and the Anglo-Japanese rivalry in the cotton industry. A number of special articles are included, obviously from authoritative sources wherein conditions in all parts of China are discussed. A department devoted to reviews of books, especially books on the Far East, is to be a feature.

"Oriental Affairs" decidedly is worth while and should have interest and real value both to readers in the Far East and elsewhere.—*val.*

Japan's Attitude Toward America

SOME idea of the Japanese attitude toward public opinion in the United States was set forth plainly in an interesting address that was delivered in Seattle on October 5, before the Japan Society by Mr. T. Shiratori. For a long time Mr. Shiratori served as an official at the Foreign Office at Tokyo in the capacity of Director of Intelligence and his contacts through this period were such as to qualify him specially to deal with the subject of his speech in America. He was recently appointed Japanese Minister to Sweden and Denmark and he was on his way to assume his new post when he visited Seattle. His address was as follows :

About the Manchurian Affair all that has to be said on our side has been said with more or less effect in this country as well as elsewhere. Suffice it to say that the State of Manchuria or Manchoukuo is an accomplished fact, we at least regard the matter in that light. What is now of importance is not the manner in which it was called into being, quite justifiable as we believe it to be, but the question now is whether the New State is going to make good. The present indications are that it will, that it has come to stay. Already, the people in that territory, mostly Chinese, are faring incomparably better than they did under the former régime. State finances have been placed on a sound basis, trade and commerce are prospering as never before ; peace and order have been completely restored, there being much fewer bandits than before even in the remotest regions. Altogether, Manchuria to-day presents a very striking contrast to China Proper.

Japan has spent hundreds of millions of Yen and has lost thousands of lives in bringing forth this satisfactory state of affairs. She will have to continue making sacrifices for some time yet. What has she gained in return ? Little beyond what was her due by treaty and otherwise. Had there been good government in Manchuria, able and ready to protect Japan's interests, she would have been spared all these sacrifices and the storm of censure heaped upon her by the outside world.

In face of these facts, these unmistakable facts, it is time that the world began to take a different view of the whole affair. I am confident that in this case, as in many others, the end will have justified the means. At any rate, I cannot bring myself to believe that the Manchurian Affair will really stand in the way of an amicable relationship between our two countries.

Nor do I think that Japan and America ought in any way to disagree about policy in regard to China Proper. America's main concern about China is for the Open Door. We are as much interested as, nay even more so, than America in the principle of Open Door and equal opportunity in China, for the China market is indispensable to us. So in this respect we are perfectly in accord, and, in fact, Japan and America are two countries which have in the past shown more energy than any other country in their endeavors to maintain that principle.

It is true that Japan's interest in China goes much deeper than the needs of trade and commerce. Japan and China are such close neighbors, and they are so intimately bound up to each other politically, economically and socially that whatever affects one affects both. Suppose, for instance, that China were to fall into the hands of some strong military nation. That would mean a formidable potential enemy at our door. Again if China were given up to the plague of communism, Japan would be swept away by the same evil. Our interest in China is therefere political as well as economic.

Our position *vis-à-vis* China is not unlike that of the United States towards Latin America. We have, however, infinitely more reason for concern about China than America has about the Central and South American countries. The country has been torn by civil strife. A vast portion of the land has been placed under communist rule which is spreading like wild fire. Lives and property of foreign residents are daily exposed to danger which might easily invite armed intervention by some country or other. In face of such a situation, it would take much more courage than was shown by President Monroe were Japan to commit itself to a policy similar to that proclaimed by him. Declaration or no declaration, however, the Japanese people feel that they are destined to play the same rôle in their part of the world as America does in hers. They feel that they are capable of discharging their mission as conscientiously as America does hers.

I know that after Manchuria and Shanghai such a statement from a Japanese is very unpopular in this country. But I must request you to ponder more deeply and see if you cannot show more generosity. Call a man a thief and he will steal. Treat him like a hero, and he will act greatly. Why don't you, why does not the world trust Japan and place the responsibility upon her shoulders for the peace of the Far East ? We have time and again expressed willingness to assume such a responsibility. We even staked our very existence in fighting a powerful nation to safeguard that peace and to discharge that responsibility. You cheered us then. Why do you frown upon us now when we fight chaos in China in order to put an end to the internal menace to the peace of the Far East ?

I know that you are somewhat puzzled at my speaking of these things before you when you have all but foregotten Manchuria and China. We cannot think of our relationship with America without thinking of America's attitude toward our China policy. Japan has done nothing in the past on the continent of Asia of which the people and Government of America did not approve. Upon the annexation of Korea by Japan, America quickly withdrew her legation at Seoul to express her acquiescence in the arrangement. The set of treaties emanating from the famous 21 Demands of 1915 had likewise the approval of the Wilson administration, Japan having dropped all the items in the demands to which Mr. Bryan had raised objection. In the past Japan responded with alacrity to every desire expressed by the United States. About Manchuria, for the first time since the days of Commodore Perry, Japan has decided to go her own way in spite of American remonstrances.

Is it because we have ceased to value the long standing friendship of America ? By no means. America's good will and her good opinion are as valuable to us to-day as they ever were. If, in spite of that, Japan had to choose the course she did, I think we are not asking you too much when we request you to go beyond the surface of things and try to grasp the true significance to Japan of the China situation. You will then find that after all Japan has done nothing, will do nothing, in China which Americans cannot in conscience approve. I am not saying this in any carping spirit. I have only been giving vent, before friends of Japan, to my inmost thought and hope.

I do not ask you to take me at my word, but allow me to say that a nation with Japan's sense of honor and her clean record in the past cannot have done anything very wrong, all surface evidence to the contrary notwithstanding. Time will reveal to you the entire Far Eastern situation in its true perspective. A question of more immediate concern to Japan and America, although of far less importance than the China question, is that of Japanese emigration to America. Nothing has recently so cheered the hearts of America's friends in Japan as the report that the movement was newly set afoot in this country for the amendment of the Emigration Act. Of course this is essentially an American question about which we Japanese have little right to say anything. No matter whether it succeeds or not, the people of Japan are gratified at the thought that the movement has the support of a considerable section of public opinion in America. With us Japanese, the whole question of emigration is one of sentiment.

The Japanese Government have long abandoned any idea of sending more emigrants to this country. The utmost we request of America is that those Japanese who are lawfully here should be treated fairly. We know that they are. We do not ask for any increase of the number of yearly new comers. Our sole complaint is about the insinuation back of the Emigration Act. That being the case, I, for one, am of the opinion that the remedy need not necessarily be sought in the amendment of the Act itself, most simple and effective as the method seems to be. To my mind, America made a mistake at Versailles when she turned down Japan's proposal for the adoption by the League of Nations of

(Continued on page 536)

Some Aspects of Electrical Power Development in China

By A. J. PERCIVAL, Managing Director, Messrs. Inniss & Riddle (China), Limited

(The following is an address which was given before the China Center of the Institution of Electrical Engineers at the Annual Dinner of the Institution on November 23, at Shanghai).

NEXT year the examination for the graduate membership of our Institution will contain the optional subject of Engineering Organization, Management and Economics. This innovation suggested to me that it might be opportune to review some of the aspects of electrical power development in China.

Regulations

The Lytton Report gave as its considered judgment that China generally has progressed in recent years in spite of all that has happened. As regards the progress of electrical development no reasonable doubt can exist. Until the present form of government began in Nanking six years ago, practically no attempt had been made to regulate or guide electrical development. Three years ago the National Reconstruction Commission issued Technical Regulations for Chinese Electric Supply Utilities. These were largely a blend of British, European and American practice, the standard frequency adopted, 50 cycles, being the British and European frequency and the standard voltages perhaps nearer the American standards. They have also issued rules or regulations for the registration of electric supply companies, for Indoor and Outdoor Wiring and regulations concerning the theft of electric current.

An annual Statistical Investigation of Electric Power Plants was commenced by the Commission three years ago and this will be increasingly useful especially as it becomes more accurate.

Regulations are one thing and their execution another but such plans must be the first step just as designs and drawings are the first steps in engineering construction and, in spite of tremendous difficulties due to political and economic disorganization, results are being achieved.

The regulations as a whole have wisely been framed with one eye on existing conditions and one eye on the future but there is one technical point on which I would like to comment. The Chinese Electrical Service Regulations allow of ten per cent difference between actual and declared voltage as compared with the four per cent allowance in England. From a technical point of view, ten per cent variation is too much as it is sufficient to cause difficulties in the performance of motors and other electrical devices on the system.

Yet one only has to be in the average Chinese city at night to realize that the actual voltage variation must be anything up to forty per cent, at all events on lighting circuits but again, the engineers concerned are very conscious of this and are doing their utmost in extremely difficult circumstances. To-day in China undue emphasis is very apt to be laid on efficiency of generation to the neglect of efficiency in distribution.

Standardization of frequency is a most important national matter which the Commission are quietly doing their utmost to bring about. Behind the shifting political scenes they are trying hard to induce Canton and certain other important cities to adopt the national frequency. They recognize that every year that this is delayed will greatly increase the ultimate cost which will some day have to be met. The cost to Great Britain of standardizing the frequency of 50 cycles under the grid scheme during the last six years has been not less than seven million pounds Sterling. The Hongkong Government has shown the way in this part of the world by bringing about, in the last three years, the change in frequency at Kowloon and in the Leased Territories to that of Hongkong itself,—50 cycles.

Gradually no doubt we shall see Chinese standards tightened up for all classes of electrical apparatus and it is particularly desirable that better standards for insulation of wire and cables, switchgear and small apparatus be adopted at the earliest possible moment, if only because of the excessive loss of life due to present day practice. Most of this loss of life goes unreported but two or three electrical fatalities per month have been recorded recently by the Shanghai Municipal Council alone.

We should also like to see uniform standards for allowable temperature rise in motors and generators. The British markets have adopted 40°C. as against the 50°C. of America and the Continent. This means that for the same power output the British machines are about 15 per cent heavier but allow of overloads, which are so frequent out here and which the more highly rated machines generally will not stand for long without injury.

Potential Developments

We have all listened to speeches or read statements in which we have been told that one solution of the world's unemployment is the economic development of China.

This is particularly misleading as regards the electrical position and is partly responsible for such a concentration by the world's electrical manufacturers on the China market that prices obtainable are not only frequently unremunerative but electrical manufacture in China itself is not worth while, and it would require extremely complex tariff walls to enable local manufacture to be successful without cramping development. It is of course not dumping that is taking place as power plants and motors are certainly not surplus products in the countries of their origin.

The hydro-electric possibilities of China in particular have been grossly exaggerated. To-day the average daily output generated by hydro-electric means in China does not exceed 1,000 kw. and unfortunately where the necessary hydraulic and site conditions exist, they are too remote from the possible load or distribution centers to make their utilization economic. That is particularly true of the Yangtze Valley in spite of newspaper and other reports to the contrary.

Economic stagnation in China must continue, except perhaps in such relatively favored places as Shanghai, Canton and Tsingtau, until an adequate system of transportation exists. This in turn waits on finance.

The subject of transportation reminds me that the October issue of a London monthly journal, which is intended to cover engineering developments in the Far East, contains an interesting leaderette about the difficulties experienced in the transporting of an electric power and lighting plant which my firm happened to supply and engineer for a town in the province of Yunnan near the border of Szechuen. They said that over a thousand coolies were employed to man-haul the cases over the mountain and that many of the coolies suffered from hemorrhage and that some died. Actually about a hundred coolies were used so that someone merely added another cipher and brought the number to a thousand. Several coolies unfortunately did lose their lives but that was due to inexperience in the handling of heavy weights which we did our utmost to reduce to the absolute minimum.

Incidentally it was much easier to get the plant to the site, which is more than 5,000 feet above sea level, by way of Haiphong and Yunnanfu. Looking at the map, Chungking appeared to be the best port of entry but Chungking was more than three hundred miles distant and several mountain ranges were in the way. As it was, the tracks over the mountains and valleys for the last hundred miles had to be often quarried wider to allow the caravan to get through.

Finance

The total of current accounts and deposits with the Central Bank of China and the 28 Chinese banks that are members of the Shanghai Bankers' Association is to-day stated to exceed 2,000 million Chinese dollars. Conditions, however, are so uncertain and the elements of sound finance so often neglected in responsible quarters that it has been found impracticable to underwrite public issues of capital for Chinese domestic industries and utilities. Until our Chinese friends are more willing or more able to venture their wealth in this direction it is very unlikely that foreign capital will become available if it is required.

Yet here signs of progress are visible and the fact that Chapei, Nantao and Pootung will shortly be electrically interconnected to a much larger extent than they are to-day with the Shanghai Power Company's system, points to another way in which co-operation is proceeding.

Education

Another serious but passing handicap from which China is suffering is the lack of a sufficient supply of experienced practical engineers. I have already mentioned the Lester School and Technical Institute and we welcome the decision of the Trustees to brook no further delay as we are in no doubt whatever as to the urgent need of practical technical instruction to men of the foremen type for whom, I understand, the Technical Institute is primarily intended.

A competent Chinese factory inspectorate with the necessary experience and technique has yet to be created and the Lester Institute will, I feel sure, prove extremely valuable in this respect in years to come.

During the next fortnight seven Chinese university graduates are leaving China to become student-apprentices in British engineering works under the scheme promoted by the Federation of British Industries assisted by the Universities China Committee in London. The majority of them are going to electrical manufacturers works, and we hope they will in due course become members of this Institution and that the scheme and the shipping companies who are so generously assisting it, will be active for some years to come.

There has been an astounding increase in the number of Chinese educational institutions in the last six years especially in this province of Kiangsu, but the number in existence, which are equipped in any way whatever for practical instruction in electrical engineering, can be counted on the fingers of one hand. All but one or two of these are invariably crippled by lack of funds.

This situation inevitably results in an altogether too bookish form of training and then, when their college days are ended, they find themselves in a field where the opportunities of acquiring practical experience are as yet extremely limited. Surely they deserve all the co-operation and assistance we can extend to them.

Efficient

The overall efficiency of electrical plant is to-day so high that it can only be improved by a few per cent and in some cases by a mere fraction of one per cent, whereas in electric lighting we still show up very badly against the firefly which delivers over 95 per cent of its energy in the form of light when it switches on. Our to-day's gas-filled electric bulbs have an efficiency of only two per cent, the other 98 per cent being used up in heating the filament to the pitch at which it will glow.

Recently in England various hot cathode tubes and sodium vapor lamps have been produced which are five times more efficient than our present day lamps but, owing to the color of their light, they would not be suitable for Shanghai nights unless cosmetics are completely changed.

In China, as elsewhere in the world, far too much emphasis is apt to be laid on the last fraction of one per cent in the technical efficiency of plant. This in practice is generally swamped a hundred times by losses in administration and management and unfortunately the methods of engineering and science too often begin and end in the purely engineering side of the business.

However. in the rapidly changing world which,—to borrow an electrical expression, appears to be getting increasingly out of phase, the most useful characteristic must surely be adaptability and that is why we have confidence in the ultimate future of this great country.

* * *

Supplementing what he had said in his formal address Mr. Percival in offering a toast to the Institution paid the following tribute to Mr. Frank Gill, O.B.E.

In spite of the world depression the Institution of Electrical Engineers continues to grow not only in the number of its members but in the extent and variety of its activities particularly overseas.

Here in China we have been extremely fortunate in having with us a past president of the Institution, Mr. Frank Gill.

Mr. Gill's reputation is international and I think it is safe to say that it was due to his efforts in many countries in connection with the standardization of telephone plant and practice, that international telephone communication exists to-day. Whatever may be the opinion of backward looking people as to the benefits of what we call civilization, surely the art of international telephone communication is an unqualified blessing and we hope it may soon be extended to China.

Since Mr. Gill came here from the World Power Conference in Japan three and a half years ago, he has most ably shouldered the task of the transfer and modernization of the Shanghai Telephone system and at the same time he has been untiring in his efforts for the general welfare of the community and in particular that of his fellow engineers, both Chinese and foreign.

He has pioneered the work that is now going on to increase the usefulness of the various technical bodies in China by co-ordinating their activities. He has devoted much time and thought to the selection of Chinese university students for training in England under the Federation of British Industries and other schemes and also he has always been ready, from his wide experience, to help in the preliminaries of the Lester School and Technical Institute.

All this and very much more Mr. Gill has done quietly and effectively and, although it has left him but little time even if he had the inclination—for what Herbert Spencer called the "Social Treadmill,"—I think I can safely say that no visitor to Shanghai has ever made so many and so real friends as Mr. Gill has in these few years.

Gentlemen, I have much pleasure in asking you to drink this toast, "The Institution of Electrical Engineers" coupled with the name of Mr. Frank Gill, past president, to whom we wish continued health and happiness in the new sphere of activities for which he is so soon leaving us.

The Crisis in Fukien and the Policy of the Government*

By WANG CHING-WEI, President of the Executive Yuan

THE establishment of the Republican régime in China has been followed by many political complications and armed conflicts. But very few revolts in the past are comparable to the present rebellion of Chen Ming-shu and his associates in Fukien, a rebellion which aims at the complete overthrow of the existing political system of the country. There was the attempt, in the 5th Year of the Republic (1916), of Yuan Shih-kai to transform the Chinese Republic (*Chung-Hua-Min-Kuo*) into a Chinese Monarchy (*Chung-Hua-Ti-Kuo*), to be known as the Hung Hsien Empire—the first revolt in the history of the Chinese Republic which attempted to change the existing form of the State. It lasted but 80 days, however, and disappeared. In the following year, Chang Hsun sponsored a movement aiming at the restoration of the Manchu Dynasty and the establishment of the Great Ching Monarchy (*Ta-Ching-Ti-Kuo*). But this second revolt which had as its objective the alteration of the form of the State, lasted scarcely more than ten days and just fizzled out. And from that time onwards the futility of starting any movement for the overthrow of the Chinese Republic became apparent.

In the 17th Year of the Republic (1928), however, the Communist Party established in the bandit-infested areas a so-called Chinese Soviet. It was not intended to transform the Republic into a Monarchy, but the basic foundation of the Chinese Republic was changed ; the principle of equality among the citizens was discarded ; the people became divided into two classes. One may plunder and massacre at their will, the other must submit to plunder

* *The People's Tribune*

and massacre without protest. This meant a fundamental alteration in the conception of State—the third revolt which aimed at changing the political basis of the nation.

Recently in the 21st year of the Republic (1932) the puppets in the Three Eastern Provinces established the bogus state of "Manchoukuo" and ostracized themselves from the Chinese Republic—the fourth revolt which aimed at overthrowing the Republic of China.

During all these 22 years, only these four revolts have occurred which had as their objective the alteration of the form of the State. It being contrary to the wishes of the people, very few people have dared to start such a kind of revolt. It is thus beyond my imagination how that Chen Ming-shu have dared to start the present trouble.

On November 22, Chen Ming-shu and his associates were inaugurated as members of the so-called "People's Revolutionary Government" (*Jen-Min-Ko-Ming-Cheng-Fu*), which, on that occasion, issued a Manifesto under the date of "the First Year of the *Chung-Hua-Kung-Hu-Kuo*" (Chinese Republic). There is little difference between the terms "*Min-Kuo*" and "*Kung-Hu-Kuo.*" A perusal of the contents of the manifesto however, reveals that the rebels have fundamentally changed the foundation of the State. Discarding the principle of equality for all citizens which is one of the cardinal principles upon which the Republic of China is built, they encourage one portion of the people to persecute, despoil, and massacre others, and in so doing, have placed themselves in a position little different from that of the unlawful régime in the bandit areas. While, although they are living in the Chinese Republic (*Chung-Hua-Min-Kuo*), their organization is not much different from the puppet state of "Manchoukuo." Such is this fifth attempt to alter the nature of the Chinese State.

Moreover, the two words "First Year" are designed to completely set at naught the 22 years' history of the Republic; the blood which our Revolutionary martyrs have shed, first for the establishment, and, later, for the support of the Republican régime; the history of the Kuo-Min Tang which has taken upon itself the responsibility of establishing the Republic; and above all, the Three People's Principles, the basis upon which the Kuo-Min Tang founded the Chinese Republic.

This is an offense which established the rebels as inveterate enemies of the nation, not only among the members of the Kuo-Min Tang, from the standpoint of the Kuo-Min Tang, but also among the people of the Chinese Republic, from the standpoint of the Chinese Republic. Thus, if we do not want to see the Chinese Republic degenerate into a bandit-infested country or into a puppet state, the extirpation of the ringleaders of the rebellion in Fukien is a *sine qua non*.

Some people are inclined to fear that the present revolt may unsettle and disturb the policies of the Government. I wish to state however that the Government's policies will not and cannot be disturbed. In a circular telegram I issued jointly with member Chiang (*Kai-Shih*) on July 28, we pointed out that the means of national salvation and preservation to-day lay in bandit suppression and reconstruction immediately, and, fundamentally, in the development of productive enterprises to develop the strength of the people (*Min-Li*) and consolidate the vitality of the nation (*Kuo-Li*). These words hold good now as they did then, there being no other way to national salvation.

With reference to the work of bandit suppression, I wish to emphasize the fact that the communists have perpetrated in the bandit areas outrages of which not only communists in Europe, America or Japan, but even communists in Russia, are incapable. Their actions are scarcely distinguishable from those of the notorious bandit-chiefs, Li Tzu-cheng and Chang Hsien-chung of the Ming Dynasty. The reason why the Chinese communists are perpetrating such depredations is entirely due to their own whims and to misinterpretation of their original doctrines.

The economic conditions in China are such that the objects embodied in the "Principle of the People's Livelihood" expounded by the late Party Leader (*Dr. Sun Yat-sen*) cannot be attained by radical but by moderate and peaceful measures. Thus, while advocating revolutionary methods for the political revolution, our late Leader expressed himself as being strongly in favor of the employment of moderate and peaceful measures for the attainment of economic improvements. Ignorant of the social and economic realities in China, however, the communists have disseminated the doctrine of class-struggle and created a state of pandemonium and confusion. The people are arbitrarily divided into various classes, and as massacre and incendiarism have become elevated to a political creed no one is free from the danger of being despoiled or murdered outright.

And while engaged in plunder and massacre, their senses get benumbed and they cannot check themselves. The communists thus rob and kill not only their intended victims, but also those of their own ilk. A detailed account of the horrible conditions in the bandit districts, based on the result of concrete investigations, is contained in the Sixth Report of the Rural Rehabilitation Commission. While the population of Kiangsi province was formerly over 26 millions, it has now decreased to less than 20 millions—a loss of six millions, which is a figure unprecedented in any former war or disturbance. Whereas the main casualties during the wars of the militarists in the past were mostly soldiers, it is the innocent civilians who now form the bulk of the victims of communist terrorism. In the so-called "Ten Thousand Men's Pits," the corpses of thousands of people are piled up in a most ruthless manner, so that the lot of the people in the bandit-infested areas is much worse than that of beasts. The devastations in the bandit areas are really too horrible to imagine. Bandit suppression is therefore the most urgent task of the nation at present. So long as this is not accomplished, all other work cannot be done. How can we exterminate communist banditry? On the one hand, we must adopt military measures; on the other, we must employ political and economic means to develop the productive enterprises. Only thus can the problem be fundamentally solved.

Such being the crimes of the communist bandits, it is to be deplored that some people are now working for the transformation of the entire province of Fukien, nay, even the entire country, into bandit areas. This, if realized, would not only mean the extinction of the nation as an independent State but also the extirpation of the Chinese race. What can be more lamentable than this state of affairs?

It is rumored in certain quarters that the Government has met with reverses in the bandit-suppression campaign. I queried Chairman Chiang (*Kai-Shih*) by telegraph on this particular point. A reply just received from him states that ever since the commencement of the campaign last month, the Government has been victorious in every battle that has been fought, the more important being those at (1) Hsiaoshih and Tzuchichen, (2) Suwan, (3) Tengtien, (4) Tahsiungkwan, and (5) at Shenkang and Tangkow. The 1st, 3rd, 5th and 7th Group Armies of the bandits have taken part in one or the other of these battles and have all sustained severe casualties. In the battles of Suwan, Tahsiungkwan, Shenkang and Tangkow, the numbers of captives taken were particularly great. It was personally admitted by Lo Niu-chang, Vice-Commander of the 6th Division of the bandit forces, who has been taken captive, that the losses sustained by the bandits amounted to one-third of their total strength. The new policy of campaign adopted by the Government forces—that is, fortification of ground gained and gradual round-up of the marauders—has considerably brightened hopes for the early conclusion of the campaign. We must realize not merely the imperativeness of bandit suppression but also the feasibility of the task. The various rumors are disseminated by the bandits, and must not be taken seriously. We must redouble our efforts for the suppression of the Red banditry, so as to deliver Kiangsi from the Red terror, and save Fukien and the entire country from the Red menace. This is our responsibility towards the State and the people.

The plans of bandit suppression and national reconstruction having been decided upon, the foreign policy of the Government has also been settled. It is alleged in certain quarters that the Government's foreign policy is somewhat weak-kneed and affords therefore a pretext for opposition. I am of opinion however that in deciding upon a foreign policy, we must take into account our own strength as well as the circumstances in which we are placed. Once we have decided upon a definite policy, we must stick to it, whatever criticisms or opposition there may be. We must under to circumstances deviate from our settled policy: for if we do we shall only lead the country to extinction.

After the outbreak of the Shenyang (*Mukden*) Incident on September 18, 1931, I attacked the then Northern authorities for their policy of non-resistance. For this, I have in turn been criticized for being too strong in my stand. In May of the current year, I took upon myself the responsibility of concluding the Tangku

armistice agreement ; for advocating the cessation of hostilities, I was criticized for being too weak. Both of these criticisms, however, are unwarranted.

I had at first opposed the North-China authorities because they had persisted in a policy of non-resistance. Later, I took upon myself the responsibility of bringing about the armistice because after three months of severe fighting along the Great Wall, our forces were forced back and Tientsin and Peiping were in imminent danger ; just as in the Japanese invasion of Shanghai, and Woosung area on January 28, 1932, up to February 20, I gave my wholehearted support for resistance but on March 3, when our front lines had collapsed and reinforcements were, for various reasons, not available, I took upon myself the responsibility of bringing about the cessation of hostilities. The very persons who were relieved by the cessation of hostilities during the Japanese invasion of Shanghai, however, have now come out in opposition to the cessation of hostilities in North China. This would be tantamount to saying that the Government should bring about the cessation of hostilities when they themselves were suffering reverses but that it should force others to what is certain death when others are suffering the reverses. This sort of argument can never stand.

In this connection, let me remind you of the history of the last part of the Ming Dynasty under the reign of Emperor Chung Chen. At that time, the country was menaced by the Manchus outside the Great Wall and by bandit disturbances within, and the Government was helpless in dealing with the situation. The Commander of the Government forces in charge of military operations outside the Great Wall, Yuan Chung-huan, said : " A defensive policy is the regular policy : an offensive policy is an extraordinary policy : while a peaceful policy is a side policy." He also pointed out the necessity of " gradual instead of sudden movements, concrete instead of high-sounding measures." He had tried to bring about an armistice agreement with the Manchus, being convinced that in order to deal effectively with the external menace it was necessary first to put down the domestic disturbances. The officials of the day, however, in total disregard of the strength of the Manchus, the bandits, or the Government forces, did nothing but clamor for war. They condemned a policy of peace-making as weak-kneed, and those engaged in bringing about peace with the Manchus as traitors. Under such circumstances, Yuan Chung-huan was painfully disappointed. Influenced by the courtiers, Emperor Chung Chen did not know what course to follow. Because of his advocacy of negotiations for peace, Yuan Chung-huan was executed, and with his death passed the Ming Dynasty. Instead of attributing the fall of the Ming Dynasty to the Manchus or the bandits, we should attribute it to the misplaced pride of the officials.

Present circumstances are vastly different from those of five or six decades ago. Due to a number of reasons, China has fallen behind both in political, economic, military and cultural respects. Our strength cannot be compared with that of the Ming Dynasty during the Manchurian invasion. This is in no way intended as relieving myself from my responsibility towards the nation. When driven to the last extremity, I shall not hesitate to advocate that the nation should make the supreme sacrifice if only for the sake of safeguarding the national honor. So long, however, as there is still a road for national salvation and self-preservation, such an opportunity must be utilized. " Applying to others for help is not so wise as applying to oneself," an old saying states. I would add, " We must not so much blame others as ourselves." We must look to ourselves to find out why we are behind others in political, economic, military and cultural spheres. So long as the nation remains in existence, we must exert ourselves for its improvement. In order to survive in the world, the nation must strengthen itself. Only one which is strong enough to be the enemy of other countries is fit to consider itself their friend ; conversely, only one which is fit to be friend of other countries is in a position to be their enemy. And while bandit suppression and development of the productive enterprises are within the province of domestic affairs, they are also related to foreign affairs. The accomplishment of these tasks is at any rate better than mere pride and placing confidence in fate. Why should we depart from our policy of national salvation and self-preservation simply because of attacks from a few persons ? In other words, for the sake of the nation, personal life or reputation can be set at naught. Those who are disposed to attack us, let them do so.

Evolution of Manchoukuo Airways

By SHUJI TSUJI in the Mainichi-Nichi Nichi

On the Meijisetsu, November 3, falls the first anniversary of the air link between Japan and Manchoukuo, on which day a huge plane from each country met at Shingishu, Chosen, close to the Manchoukuo border, where greetings of leaders of the two countries were exchanged.

From then on the Manchoukuo Air Navigation Company has made phenomenal progress, doing a big bit toward developing the country. Since moderns are accustomed to gauge city to city distances in terms of so many flight hours, it may not be entirely useless to cast a glance at Manchoukuo's airways.

The Manchoukuo Government, in its eagerness to place its transportation facilities under effective control since the birth of the state, has turned its attention toward perfecting the nation-wide airway network which is a logical link in the Asia to Europe trunk air line. After carefully studying the situation, the Government has decided to form an air transport company as the first step.

Those who are familiar with Manchurian geography will appreciate the fact that aircraft are the most natural and logical medium for connecting cities, towns, and communities scattered over that vast expanse of territory, and that a regular air route can contribute materially toward developing industries and stimulating cultural attainments. The creation of an air transport company was, therefore, looked forward to with much enthusiasm.

The Manchoukuo Air Navigation Company, a joint Manchurian and Japanese enterprise, was established on September 26, 1932. The concern is financed jointly by the Manchoukuo Government, the South Manchuria Railway, and the Sumitomo Goshi Kaisha.

Inasmuch as the venture will not be a paying proposition for some time to come, all the investors put up their money without any immediate prospect of receiving interest or dividends from the funds invested, the subsidies from the Manchoukuo Government and the S. M. R. taking care of the operating expenses.

The corporation is formally registered with the Manchoukuo Government, and is capitalized at Y.3,850,000 in Manchoukuo currency, which is represented by 7,700 shares. The company has its headquarters in the railway zone of Mukden, while a branch is located in the Osaka Building, Uchisaiwai-cho, Kojimachi, Tokyo.

Listed below are the lines of business carried on by the Manchoukuo Air Navigation Company :

Air transportation of passengers, mail and freight across Manchoukuo and to countries bordering Manchoukuo ; construction, assembling, or repairing of aircraft ; leasing of aircraft upon the instructions or approval of the authorities concerned ; and all other phases of the air navigation business.

On the 1932 birth anniversary of the Emperor Meiji, November 3, the Company's fleet began operations. Under the direction and supervision of authorities, the company's fleet has been making flights, with and without regular schedule. On that memorable day the trunk air lines of Japan and Manchoukuo shook hands.

From the Japan side, a Fokker Super-Universal monoplane (JBAVO), flown by Aviator Umezo Aoki and Mechanic Rihei Okada of the staff of the Japan Air Transport Company, left the Kizugawa Airport, Osaka, at 8.33 a.m.

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Basic Facts Bearing on Philippine Gold Mining*

The Definitely Known Mineralized Belt Extends North-South from the Pacific to the Celebes Sea—Richest Sections Little Explored

THERE is a good deal of curiosity in men's minds as to why it is, if there is much gold in the Philippines, great gold-mining development has not occurred in the past; and why the boom comes now, delayed 33 years after the American occupation of the islands. The second of these natural queries is readily satisfied. The records amply substantiate what will be said. It is this: Campaigning in the Philippines, American soldiers found many evidences of gold deposits and rich placers. These soldiers were without funds, practically speaking—had no way of following up their discoveries. Those who found no lure in the hills, who settled down to trade in Manila and did well enough in that without being tempted to chase rainbows, needed their gains to expand their business.

Few of these men could be induced to stake prospectors or to put money into gold schemes. Some projects were financed that did not pan out, this discouraged the whole industry; and dredging was tried where proper mining would have been more the thing to do, as mining is now about to open up on the old Paracale dredge workings. Prospectors who knew their claims were valuable often held them as long as they could, many dying of exposure, hardship and malaria from living on their claims in the vain hope of finding financial backers to develop them. But some, as some at Baguio, stuck it out successfully until the Benguet Consolidated and Itogon mines began making money and public interest in mining ventures began asserting itself. In this desperate way the old Acupan claims, now the Balatok mine, were held; and Tom Phillips, one of the original stakers of these claims, actually registered them on the last day he had in which to do so. He lives, though in bad health, to tell the story.

Phillips came here with a dredging outfit from Australia. The first mine adequately financed and persistently developed was the Benguet Consolidated. As it is only now that the true resources and real worth of this great mine are coming to be known, so it is only now that interest in mining has become general: and this inclination to venture in mining is enhanced by the depression that has knocked profit out of other enterprises. There has also, in 30 years, been much improvement of mining machinery and methods of making low-grade ores pay for the milling of them, and adaptation of the diesel engine to needs of mines for power. Finally, gold regions have been made more accessible by roads and trails; hardships of getting to them and camping in them are greatly lessened. The airplane helps too, and one mine 35 kilometers in the mountains is being provided with an airfield to enable the owners to get men and supplies to it.

This use of the airplane in mining is followed in New Guinea. It is practical.

Now for the first query. Why, if there is probability of much gold in the Philippines, was gold mining not developed long before the Americans came here? Or, what is the basis for the belief that there is much gold here?

Geologists have long known of the very extensive mineralized zone in the Philippines, perhaps no less than 1,200 miles long, and in many places 10 miles wide, beginning north at a point on the Pacific ocean midway between Bangui and Claveria and running south through Davao to the Celebes sea. In a past geological age, the Philippines broke in two along this zone. This is what created the zone. Water boiling from earth's depths gurgled up through the faults along the break, spread through them and dropped, as it cooled, the minerals it held in solution while hot. So the whole zone was mineralized. Among the minerals are iron, copper, silver, chromite, gold and at least some platinum. Thus if you find gold at Baguio, it is not unreasonable that you find it at Ipo, Salacot, Balete, down through the Bikol peninsula, over in Masbate, Samar, and Leyte, and on into Surigao and Davao. This is a huge region and requires vast exploration before much can be known about it.

Reliable mining men who have gone pretty well over the field are of the opinion, from the surface indications, that the richest portion of the whole zone is the one in Surigao and Davao, the portion that has been least explored—where gold is indeed known to exist but where no mines exist and very little placering is done. Take Masbate, for example. On the gold belt around Aroroy gulf in Masbate are two flourishing mines, Paniqui and IXL. Both yield low-grade ore, Paniqui Mines, Inc., having bought a few years ago the old Syndicate property. Net profit from millheads is about one peso a ton, and the Paniqui mines mill 250 tons a day. Ben Berkenkotter, who formerly worked for the Syndicate company, is practically sole owner of Paniqui Mines, Inc. Six miners together own the IXL. There seems to be no limit to the ore at the disposal of these mines, now profitable to mill because of the highly improved and economical methods that may be applied to the business. Here, then, are just two little bits of the potential goldfields of Masbate.

Arthur Bridle, who has mined in Masbate for many years and is a very practical miner by common repute, says there are at least six other regions of Masbate equally as promising for gold as the Aroroy region, by the surface indications. In other words, all the mining that has been done in Masbate has not, as Bridle expresses it, scratched the surface. He says the *three M's*, Masbate, Mindoro, Mindanao, have not even been superficially explored for gold: and he believes, from what he knows of these islands from looking them over with a keen miner's eye, they will all be great gold-bearing islands in the future. The conclusion is, not much has been done in the Philippine goldfields because there has been so very much to do and so very little with which to do it—little cash and few experienced men.

By the way, the supposition that the name *Mindoro* derives from the Spanish *Mina de Oro*, or Mine of Gold, is in error and may be misleading. Mindoro does not lie in the gold zone, strictly: the name is of native origin and has no reference to gold. While the metal is known to exist on Mindoro, that it is extensive there does not follow.

Geologists, of course, because their explorations have been altogether inadequate to inform them, do not know how extensive gold deposits in the major mineralized zone of the Philippines are, or just where they lie, except as mining knowledge brings this to light. Streams tell most about this, and so many streams have been explored, and have yielded gold from their sands, that it is a good bet now that gold deposits are practically coextensive with the mineral zone itself. It is also a betting deduction that at thousands of points on this zone gold exists in ore rich enough to be profitably mined and milled by the modern methods now in use at the mines already paying dividends. This is a bold assertion. Its import is tremendous, nothing else than that the Philippines are probably the greatest goldfield yet discovered in the world. It stands because the practical and scientific developments are to be carefully watched by this journal itself, and independently judged, and on the occasion for the least modification of it, that modification will be made.

* *The American Chamber of Commerce Journal*

Japan's Attitude Toward America

(*Continued from page 531*)

the principle of racial equality. If America had accepted that principle, the clause in question in the Emigration Act would have been deprived of its sting for Japan.

It is difficult for the Japanese to understand why America, whose Constitution is based on the proposition that all men are created equal,—I say it is difficult for us to see why America should have hesitated to subscribe to the principle that all races of men are created equal. It would not have entailed upon this country the least obligation in regard to the racial question of emigration which is admittably a purely domestic affair of every country. Might I not then venture to suggest that the emigration question in so far as it is a question at all between Japan and America, may on some fit occasion in the future be smoothed over along some such broad line as I have just referred to?

Building Costs of Passenger Ships in Japan

A Comparison with British Shipbuilding Costs

By Y. TAJI, M.Eng., M.I.N.A., M.I.Mar.E., Etc.

THE present status of Japanese shipbuilding costs under the abnormal drop in the exchange rate of Japanese currency and under aid of the New Construction Facilities Act is more or less of a temporary nature. The governmental subsidy for new construction is for the improvement of Japanese shipping efficiency and has effected a revival of the Japanese shipbuilding industry to a limited extent. The subsidy is granted only for three fiscal years.

Some time ago a committee was appointed by the Society of Naval Architects of Japan in order to investigate Japanese shipbuilding costs in comparison with those of Great Britain under a normal exchange rate in gold currency. The complete report of the committee submitted to the Society reveals real facts in the Japanese shipbuilding situation.

It was difficult, however, to obtain complete information regarding British shipbuilding costs, these being generally treated as a trade secret. Besides this, there are some discrepancies in standards of the cost estimation in these two countries. In view of the importance of the problem, however, Japanese shipbuilders offered all necessary information to the committee.

It should be borne in mind that the comparison is limited to the building cost of passenger ships only and does not include cargo ships. In fact, the building cost of cargo motorships was lower than in Great Britain long before the drop in the exchange rate of Japanese currency.

The vessels selected for comparison were three up-to-date motor liners, the *Terukuni Maru*, the *Hikawa Maru* and the *Heiyo Maru*, which were built in the Mitsubishi Nagasaki Shipyard, the Yokohama Dockyard and the Osaka Iron Works, respectively. Actual building costs of these ships were compared with quotations from British shipyards for the *Terukuni Maru* and those deduced from the British quotations as well as from costs of similar British-built ships.

As the result of the investigation, it was confirmed that the costs of Japanese-built passenger motorships have been somewhat higher than those of British-built ships for various reasons.

Main causes for the higher shipbuilding costs in Japan may be summarized as follows :—

(1) Extra freight, insurance charges, etc., due to purchasing materials, accessories, fittings, etc., from abroad.
(2) Comparatively high labor cost and high various-charges in Japan, and also comparatively high price of materials and manufactured articles in Japan.

The proportion of costs belonging to the first category for the total cost of the complete ship, however, being not very large according to actual records, the higher price of Japanese-built ships in comparison with those built in Great Britain should be considered mainly due to causes belonging to the second category.

The rate of increase in the building cost of passenger ships in Japan ranges from about 12 per cent to 15 per cent, bearing in mind that the computation was deduced from materials purchased for these three ships. The price of the main engines of the *Hikawa Maru* was comparatively high, whilst the contract price of the *Heiyo Maru* was comparatively cheap.

This percentage consists of (1) extra cost of three to five per cent for freight, insurance and sundries for the materials, accessories, and fittings purchased abroad, and (2) relatively high cost of about 10 per cent for labor and various charges, and for the materials and articles purchased at home.

The first item could only be removed by the divisional development of various Japanese industries in special connection with shipbuilding and consequently by reducing prices for materials and manufactured goods or at least making them as low as those quoted by specialized foreign manufacturers, but most of these industries are out of the direct control of shipbuilders.

On the other hand, the causes in the second category which make the main difference between the Japanese and foreign prices, can be eliminated by the efforts of the shipbuilders themselves and other related industrialists in accordance with the general trend of engineering industries in Japan.

The causes for the comparatively high labor costs are neither in the high wage nor the lower working skill of workmen, but are mainly due to the lower aggregate working efficiency in the general operating and administrating system. When examined in detail, there are found many wastes in the preparation of work and due to the unaccustomed operation owing to the interruptions in passenger shipbuilding in Japan. It is very difficult in Japan to turn idle labor to other useful work, when such idle labor was produced due to the brevity and irregularity of work in shipyards. Further, the insufficient divisional development of various works which are in keen relation with shipbuilding and the manufacture of accessories is another cause. Besides, frequent alterations in the course of building and much additional work as well as unnecessarily careful workmanship may also be taken into the account of causes for the comparatively high labor costs in Japan.

Causes for the comparatively high rate of various charges are numerous. Amongst them, the principal yet passive cause is the indefinite status of shipyards, which are sometimes busy and sometimes idle due to the irregularity of orders for new ships. Other causes are due to special circumstances in Japanese shipbuilding, such as the necessity for a large area for yards and extensive shipyard equipment under the necessity of self-making and self-supply of various materials, fittings and accessories in their own workshops, and consequently a large capital is fixed upon them, whilst money interest is very high in Japan.

Causes for high prices of materials purchased in Japan and articles manufactured therein are mainly due to the insufficient development of industries in close relation with shipbuilding. It should not be overlooked that the price of home-made articles is influenced very much by import prices. Also the requirement for such articles as ship fittings is extremely limited owing to fundamental differences in living conditions in Japan—for instance, foreign furniture and utensils are not commonly needed for general Japanese domestic purposes.

The three latest passenger motorships under consideration are a N.Y.K. Japan-Europe liner, an Orient-Seattle liner of the same company and an O.S.K. Japan-South American liner having the following particulars and characteristics :—

Name of Ship	*The Terukuni Maru*	*The Hikawa Maru*	*The Heiyo Maru*
Length b.p.	505-ft. 0-in.	510-ft. 0-in.	460-ft. 0-in.
Breadth	64 „ 0 „	66 „ 0 „	60 „ 0 „
Depth	37 „ 0 „	40 „ 0 „	40 „ 6 „
Draught, full load	28 „ 6 „	30 „ 0 „	30 „ 0 „
Gross tonnage, tons ..	11,931	11,622	9,816
Registered tonnage, tons ..	7,156	6,788	5,871
Under deck tonnage, tons ..	8,372	9,388	7,990
No. of passengers, 1st class ..	121	79	42
ditto, 2nd class	68	69	80
ditto, 3rd class	60	138	500
Main engine, No. and type ..	2-Sulzer 2-cycle single-acting	2-B & W 4-cy. double-actg.	2-Sulzer 2-cy.-s.a.
No. of cylinders, bore and stroke	20-680 mm. by 1,200 mm.	16-680 mm. by 1,600 mm.	16-680 mm. by 1,000 mm.
Trial i.h.p. and r.p.m. ..	14,368 i.h.p. 110 r.p.m.	18,272 i.h.p. 121 r.p.m.	10,493 i.p.h. 118 r.p.m.
Trial speed, knots	18.02	18.38	16.70
Light load displacement ..	9,220 tons	9,976 tons	7,650 tons
Hull steel weight, net. ..	4,950 „	5,750 „	4,330 „
Hull, other weight, net. ..	2,270 „	2,026 „	1,745 „
Machinery weight, net. ..	2,000 „	2,200 „	1,575 „
Completed	May 31, 1930	April 25, 1930	March 15, 1930

The total building costs, total material costs, total labor costs and various charges, percentages of the last two items against the total building cost, and each cost per ton of gross tonnage are given in Table I.

TABLE I.

	Name of Ships	Terukuni Maru	Hikawa Maru	Heiyo Maru
Total building cost	Gross tons	11,930	11,621	9,815
	Actual, Yen	6,177,500	6,550,000	4,600,000
	Percentage of total cost ..	100	100	100
	Per gross ton, Yen	518	564	469
Total material cost	Actual, Yen	3,728,507	4,291,157	3,106,105
	Percentage of total cost ..	60.3	65.5	67.2
	Per gross ton, Yen	313	370	316
Total labor cost & misc. charges	Actual, Yen	2,448,993	2,258,843	1,493,895
	Percentage of total cost ..	39.7	34.5	32.8
	Per gross ton, Yen	205	194	153

Classifying the total labor cost into the hull and machinery, and dividing them into home-made and imported materials, the amounts and percentages are given in Table II.

TABLE II.

Name of Ship	Home-made or Imported	Total Material Cost		Contents			
				Hull		Machinery	
		Yen	%	Yen	%	Yen	%
The Terukuni Maru	Home	1,619,290	43.4	578,715	29.6	1,040,534	59.4
	Import	2,109,217	56.6	1,396,558	70.4	712,659	40.6
	Total	3,728,507	100.0	1,955,314	100.0	1,753,193	100.0
The Hikawa Maru	Home	1,212,727	28.3	1,042,794	45.1	169,933	8.6
	Import	3,078,439	71.7	1,270,250	54.9	1,808,180	91.4
	Total	4,291,157	100.0	2,313,045	100.0	1,978,113	100.0
The Heiyo Maru	Home	1,935,108	62.5	844,678	51.6	1,090,430	74.7
	Import	1,170,997	37.5	802,199	48.4	368,798	25.3
	Total	3,106,105	100.0	1,646,877	100.0	1,459,228	100.0

N.B.—The above table shows that the *Hikawa Maru* used mostly imported materials, whilst the *Heiyo Maru* used the least of them.

In comparing building costs of these ships in Japan and Great Britain, the contract price of the *Terukuni Maru* and the estimated prices for a similar ship in Great Britain are given below :—

Shipyards	Contract or estimated price
Mitsubishi Nagasaki Shipyard	Yen 6,177,500
Fairfield & Co.	.. about ,, 5,508,400
Swan Hunter & W. Richardson ..	.. .. ,, ,, 5,460,000
Mean of above two British shipyards	.. ,, ,, 5,484,000

The above estimated price by each British shipyard is a mean of prices quoted for two ships when simultaneously ordered, whilst these two British shipyards were selected as they are builders of Sulzer type engines as is the Mitsubishi Nagasaki Works. The exchange rate was taken at 23.126d. per Yen which is a mean rate in the upper half of 1928 and is very nearly equal to the par in gold.

It will be seen from the above table, the contract price of the Mitsubishi Nagasaki Shipyard is higher than the mean estimated price of the two British shipyards by Y.693,500 which is about 12.7 per cent of the latter price.

In analyzing the causes of this higher price in accordance with the aforementioned categories, the total material cost of home-made and imported articles, and the cost required for the purchase abroad are given below :—

Item	Total material Cost Yen	Contents: Cost for home-made materials	Contents: Cost for imported materials	Contents: Cost for purchasing from abroad
Hull ..	1,975,314	578,756	1,248,730	147,828
Machinery ..	1,753,193	1,040,534	681,016	31,643
Total ..	3,728,507	1,619,290	1,929,746	179,471

As seen in this table, the total import price is Y.1,929,746 and the cost for purchasing from abroad is Y.179,471 which is 9.3 per cent of the total imported cost.

Reducing this expense from the total shipbuilding cost in Japan, Y.5,998,000 is obtained, whilst the mean estimated cost of the same ship in Great Britain being Y.5,484,000, there is still a difference of Y.514,000. This difference is due to the relatively high labor costs and various charges in Japan and comparatively higher prices for home-made materials.

Therefore, the higher rates of Japanese prices in comparison with British prices under the two categories are as follows :—

Causes	Cost, Yen	% over British Ship price
(1) Freight, insurance, etc., for purchasing materials, accessories, fittings, etc., from abroad	about 179,500	3.3%
(2) Higher labor cost and miscellaneous charges in Japan and higher Japanese price for home-made materials.. ..	about 514,000	9.4%
Total..	about 693,500	12.7%

A similar comparison was carried out for the m.ss. *Hikawa Maru* and *Hiyo Maru*. In these cases, quotations having been not invited from British shipyards, assumed British estimates were used, which were deduced from the data of the *Terukuni Maru* under elaborate calculations in net steel weight of hull, other hull weight, machinery weight, unit cost for each item, cost due to the difference in passengers' accommodations, etc. The results are shown in Table III.

TABLE III.

Items	The Hikawa Maru	The Heiyo Maru
Contract price, Japanese Shipyard (*a*) ..	Y.6,550,000	Y.4,600,000
Assumed price, British Shipyard (*b*) ..	abt. 5,614,000	abt. 4,327,000
Difference (*a*)-(*b*)	abt. 936,000	abt. 273,000
Assumed cost for purchasing from abroad (*c*)	262,000	99,700
Net Japanese Ship price (*a*)-(*c*) ..	6,288,000	4,500,300
Net Difference	674,000	173,300

Causes	Amount, Yen	% in British price	Amount, Yen	% in British price
Extra freight and insurance charges for purchasing materials, accessories, fittings, etc., from abroad	262,000	4.7	99,700	2.3
Relatively higher labor cost and miscellaneous charges, and higher prices in home-made materials	674,000	12.0	173,300	4.0
Total	936,000	16.7	273,000	6.3

The causes of such higher costs in Japan should be more concretely surveyed.

It should not be overlooked that the majority of our shipyards have a fairly old history, in that they were first established by the government at the end of the Tokugawa Shogunate (feudal dynasty) or at the beginning of the Meiji era—about 75-65 years ago—and later they were transferred to private enterprise. Locations of shipyards are convenient for wooden-shipbuilding, but convenience for the transportation and supply of iron, steel, coal, etc., and other important factors were not taken into consideration. In other cases, the dockyards were established in or near large towns where land is very expensive. In fact, the price of land in Japan, particularly in or near a large town, is abnormally high, which cannot be compared with that in any other country. This is really an original drawback.

Modern equipment in Japanese shipyards may be considered as second to none, or at least it is better than in British shipyards for general merchant shipbuilding. The majority of Japanese shipyards build and engine both merchant vessels and warships, so that various machines are often duplicated whilst some are used only for warship construction. Thus, the equipment is very up-to-date, even extravagantly so ; therefore unless it is efficiently utilized the economic construction of merchant ships is somewhat doubtful. In this connection, more flexibility is necessary in Japanese shipyards.

The capital invested in these shipyards is very large, whilst money interest in Japan has been exceptionally high. It has been usually 7-7½ per cent against 4-4½ per cent in England. Although very recently the Bank of Japan lowered the rate to about four per cent due to the lack of the movement of currency, it may be considered as only a temporary measure.

The recent free competition amongst Japanese shipbuilders has been too extreme, tending to endanger the economic foundations of competitive companies, and particularly shipyards with small capital as these may be knocked out by large companies. Under

such circumstances the reduction of capital and the amalgamation of companies having similar interests have been strongly suggested by Dr. J. Imaoka, the chairman of the Uraga and Yokohama Dockyards but acceptance of the suggestion has not been realized.

It is really necessary to take drastic measures for the improvement and reformation of administrating and organizing systems in Japanese shipyards. So far Japanese shipbuilders are making strenuous efforts for the reorganization and rectification of their own shipyards in order to reduce Japanese shipbuilding costs to a minimum.

On the other hand, it is now time for all Japanese industries to carry out a fundamental reformation under economic unification with Manchoukuo, the new independent State in the Far East.

Although recent engineering developments in Japan have been remarkable, the shortage of her natural resources has hindered the advance in the world's competitive markets. The independence of Manchoukuo and the concert with Japan have given opportunity to provide Japan with substantial supplies of from Manchuria's abundant resources. Consequently, the old industrial policy of Japan should now be reformed to meet the future developments. The industrial consolidation between Japan and Manchoukuo is very natural, both having the same spiritual ideals of mutual assistance, which should promote the well-being of both nations with consequent augmentation of the peace and welfare of the Far East.

In this connection, if Japanese shipbuilders strive with their utmost energy for the reformation of Japanese industries and for co-operation of all branches of industries which have relations with the shipbuilding industry, such as steel making, mechanical, electrical, ordinance, civil, structural engineering and the like, the present handicaps in Japanese shipbuilding can be removed without any assistance of the Facilities Act or living in the fantastic state of the exchange rate, and the glory of Japanese shipbuilding in the near future will not be merely a utopian ideal.

Evolution of Manchoukuo Airways

(Continued from page 535)

To Mr. Asajiro Terui, manager of the Nichiman Fishery Company, went the distinction of being the first Japan to Manchoukuo air passenger. The plane carried goodwill messages from Premier Saito of Japan to Premier Cheng Hsiao-hsu of Manchoukuo; from Communications Minister Minami of Japan to Communications Minister Ting Chien-hsiu of Manchoukuo: from Governor Kosaka of Tokyo Prefecture to the Governors of Kirin, Heilunkiang, and Fengtien Provinces: from Mayor Nagata of Tokyo (now a member of the House of Peers) to the Mayors of Hsinking, Mukden, Harbin, and Chichihar; and from President Hara of the Japan Air Transport Company to President Cheng Chui (now deceased). Mayor Seki of Osaka likewise forwarded his goodwill messages to the Governor of Fengtien Province, and the Mayors of Harbin, Hsinking.

From the Manchoukuo side, a similar Fokker plane left the Mukden airdrome at 7.40 in the morning. The two planes met at Shingishu, Chosen, close to the Manchoukuo border, where they exchanged greetings. The Manchoukuo plane carried goodwill messages from Premier Cheng of Manchoukuo to Premier Saito, Communications Minister Ting Chien-hsiu to Japan's Communications Minister, from the Mayors of Hsinking, Mukden, Harbin, and Chichihar to the Mayors of Tokyo and Osaka; and from the Governors of Kirin, Heilungkiang, and Fengtien Provinces to the Governor of Tokyo Prefecture.

The company's air fleet made a modest start, beginning with the Chichihar to Shingishu trunk line via Harbin, Hsinking, and Mukden, and its feeder lines. As mentioned before, the Manchoukuo air line makes connection with the Japan Air Transport fleet at Shingishu, Chosen, across the Yalu River from Manchoukuo. Since Jehol was pacified, the company's fleet has extended commercial routes to Chinchow, Shihfeng and Jehol City.

Geographically and climatically, Manchoukuo is ideally suited for air journeys. Save for occasional air pockets, the atmospheric conditions of the new state are, on the whole, extremely desirable for flights. The Manchoukuo Air Navigation Company is considering carrying freight in the near future to remote sections of the country not reached by railways.

Even now a great many officials and influential citizens in the far-off regions make it a point to go up to Hsinking whenever they have pressing business in the national capital that demands their immediate attention.

Likewise, those who have an eye on the undeveloped potentialities of Manchoukuo and those whose time is limited, can cover a surprisingly large area in a tour of inspection by air.

As Manchoukuo's railway network is rather unproportionately scant, the part that can be played by aircraft in travelling over the length and breadth of the country is altogether too conspicuous to be made light of. The fact that the regular air liners in service invariably filled to capacity by passengers and mail, testifies to the importance of aircraft in Manchoukuo.

By the time the interior regions show greater stability, which will mean growing prosperity to Manchoukuo, the present routes will be widely extended, and the number of those who travel by air will show a marked increase.

In the light of the wholesome growth of aviation in Manchoukuo during the past 12 months and the need of further air navigation for that country, one cannot but have an optimistic view of the future.

Described below are Manchoukuo's principal air routes:

(1) *Dairen-Chichihar Line*, 1,140 kilometers. This route constitutes a trans-Manchoukuo trunk airway and is divided into four stretches, such as Dairen to Mukden, 355 km.; Mukden to Hsinking, 275 km.; Hsinking to Harbin, 235 km.; and Harbin to Chichihar, 275 km. Over this route, seven round-trips a week are made.

(2) *Chichihar-Hailar Line*, 400 kilometers. Between these two cities three round-trips a week are made.

(3) *Mukden-Shingishu Line*, 210 kilometers. Over this route six round-trips are made a week (Sundays excepted). At Shingishu, the Manchoukuo Air Navigation fleet makes connection with the Japan Air Transport's fleet.

(4) *Hsinking-Lungchingtsun Line*, 375 kilometers. This route is an extremely important one in that it affords the quickest access to the Sea of Japan gateway. It is divided into three sections, Hsinking to Kirin, 100 km.: Kirin to Tunhua, 150 km.; and Tunhua to Lungchingtsun, 125 km. Over this route three round-trips are made a week.

Below this airway stretches across a vast area of Kirin's primeval forest-lands along the upper forks of the Sungari River, and the scenic grandeur of the route cannot fail to appeal to an air traveller. Following the completion of the Hsinking-Tumen Railway last summer, this air route has assumed added importance.

The Japan Air Transport Company plans to open an air route to northern Chosen on the Sea of Japan side, in which event direct connection will be made with the Hsinking-Lungchungtsun route. The Government-General of Chosen, it is understood, is appropriating a sum for subsidizing the projected route to northern Chosen.

(5) *Harbin-Fuchin Line*, 465 kilometers. This route is divided into two stretches, viz. Harbin to Chamusu, 325 km.; and Chamusu to Fuchin, 140 km. Over this route, two round-trips are made a week, but travellers will have to obtain permits before booking passage, the route not being commercialized yet.

Harbin to Fuchin is ordinarily a three day journey by Sungari steamboats, whereas by planes the route can be covered in a few hours. Near Chamusu is a colony of Japanese militia settlers.

(6) *Hailar-Manchuli Line*, 460 kilometers. This airway extends above the immense expanse of Northern Manchuria, west of the Hsingan Mountain range.

(7) *Chichihar-Taheiho Line*, 435 kilometers. This route is divided into two stretches, viz. Chichihar to Mergen, 135 km.; and Mergen to Taheiho, 300 km. It was opened last July by Government authorities. Taheiho is an important outpost, being across the River Amur from Blagoveschensk on the Siberian side.

(8) *Mukden-Chinchow Line*, 280 kilometers. This was also opened last July. The route extends along the Mukden-Shanhaikuan Railway line and over this seven round-trips are made a week.

In addition, the Government authorities are conducting regular services between Chinchow and Chihfeng via Jehol City in Jehol Province, the total distance being 750 kilometers. This route is proving of great value to the mountainous region of Jehol province, which has practically no railways.

Engineers and Doctors in China

Their Fight for Health and Human Efficiency

By Professor C. A. MIDDLETON SMITH, M.Sc., M.I.Mech.E.

A RECENT conversation with Dr. Wu Lien-teh, the famous expert now in charge of the Quarantine division of the Chinese Government, reminded me of the dependence of engineers upon the medical profession. And that led me to consider how engineers assist the doctors in the struggle for human efficiency which is taking place all over the world. It is in a particularly interesting stage in Asia.

After the experience of the first few months in the Far East, it became apparent to me that every child attending school in China needed some instruction in elementary science. Of course that statement applies also to every child in Europe and America or any other part of the world. But in China, especially, ignorance and superstition take such a terrible toll of life. It is clearly the duty of every engineer and doctor employed in China to do all that lies in his power to spread a knowledge of elementary science in this part of the world.

Thirty years ago it was my privilege to work under Sir Oliver Lodge. I have never forgotten some words that he used in a public address. He said :—" The ordinary run of men live among phenomena of which they care nothing and know less. They see bodies fall to the earth, they hear sounds, they kindle fires, they see the heavens roll above them, but of the causes and inner workings of the whole they are ignorant and with their ignorance they are content." Unfortunately, in China, the ignorance in scientific subjects of the so-called educated class causes, if not indifference. no active remedies for the ills under which so many lives are lost and great suffering endured. It is terrible to realize how much of that could be avoided.

There are a very large number of scientific people who believe that if the statesmen, politicians and financial magnates who control the destinies of nations knew scientific subjects—if they had had even a training in elementary science,—the world to-day would not be in such a parlous state. As a great Frenchman, Renan, said :—" Science will always remain the gratification of the noblest craving of our nature, curiosity ; it will always supply man with the sole means of improving his lot."

And if ever improvement in the lot of people was needed it surely is in China to-day. The story of the millions of lives lost annually by flood, famine and preventable diseases is tragic enough to spur the endeavor of any person with eyes to see and a mind capable of thought.

Constructive Economics

The present confusion, the economic chaos and trade depression resulting from the inefficiency of human endeavor all over the world, has made many a man with a scientific training despair of his fellows and the future. There is apparent such a terrible waste of human effort. Can anything seem more crazy than the facts concerning the burning of wheat and coffee and cotton while people on this earth are starving and others dying of exposure ? It is not the negation of common sense to stop production when the goods that might be produced are needed to save life and to increase human efficiency ?

What is required is a science of constructive economics that shall consider, not only the needs and development of the natural resources of a particular country, but also the efficient utilization of the vast natural resources to be found in various parts of the earth.

A concerted effort should be made by intelligent people of every nation to set forth what man *should do* on the face of the

The fight for Applied Science in China—A group of Engineering Students in the University of Hongkong. The Author, Professor C. A. Middleton Smith, Dean of the Faculty of Engineering in the center. The Chinese lady seated on his right is a Graduate in Engineering

A Group of Medical Students in the University of Hongkong. Professor W. I. Gerrard, O.B.E., M.D., M.R.C.D., D.P.H., Dean of the Faculty of Medicine in center

earth so as to secure the highest average scale of living possible for all of the various individuals. We want a record, not only what man *has* done in the face of Nature, but what he *should do.* There are vast natural resources all over the earth, waiting to be developed, that would add much to the total wealth and to the comfort of many of the inhabitants. There are immense spaces that might be occupied—Siberian forests and South American jungles—if a systematic effort to make them habitable and productive were made. Meantime millions are unemployed and millions are in want. Only the engineer and the doctor can make these places habitable. Unfortunately they cannot work without financial assistance. But educated public opinion can provide that.

Despite our boasted civilization, there is no real "science of living on the earth." It is the more remarkable when we consider how all of the other sciences have developed. But economics, as a science, is in its infancy; it has scarcely recovered from its academic birth-pangs. It is noticeable that economists all over the world just now seem to contradict each other, and to suggest irreconcilable theories for the salvage of the world's trade wreckage. Many constructive schemes have been advanced by engineers. They appear to have foundered on the rock of finance. Or has it been a lack of courage on the part of politicians and financiers?

We are in a world where changes are rapidly taking place and where in some countries, impatience leads to violence. In China we see banditry as a result of starvation.

What is needed is some plan that will build up the life of humanity, that will enormously increase human efficiency and eliminate the awful waste caused by sickness, starvation, over-work and business worries.

Something that will cure mankind of those ills that are due to a misunderstanding of topographical and economic environment. Something that will produce order out of the chaos that is now so apparent.

Public Health in China

You cannot expect sick or diseased people to be efficient workers. For the individual and for the nation "The first wealth is health." The most elementary experience teaches us that sickness makes us poor-spirited. Therefore the community as a whole should be interested in all health problems. China needs a crusade on behalf of public health.

Even from the selfish point of view of self-preservation we should be anxious to help forward any endeavor to improve public health. My probability of infection is much greater if the people around me have contagious disease than if they are all free of such things. And, remember, it is often the most healthy people who succumb first to such infection as typhoid, scarlet fever, malaria and the like. It is said that these germs multiply more rapidly on soil of a healthy body than if the victim is weak. In any case it is an obvious precaution to eliminate causes of infection, yet it is not always done. China, especially, amongst the nations lags behind in public health endeavors.

There is badly needed a science of corporate living to be taught in our Universities. The economic and industrial life of the world is at present very much at variance with its surroundings. As a collective community, called mankind, we seem to be governed by haphazard, the prey of unexplained and even unstudied social phenomena. But much can be done in China by application of the scientific knowledge, now available.

Human and Nature's Resources

We need a thoroughly impartial survey—comprehensive and reliable—of the conditions of life on this planet. We ought to know of the world's people and how they live; we want to have complete information, a real stock-taking, of all the natural resources available to mankind. We want to tabulate the natural wealth of the world. What is being wasted? What are the possibilities of the various portions of the earth for human habitation? We want to bring about a proper balance between the natural resources and the potentialities of various parts of the earth and the human element suited to inhabit it.

China is almost a world unto itself. It stretches from ice-cold regions to the tropics. It has almost every kind of climate; it can support almost any kind of vegetation. Chinese workers appear able to adapt themselves to any climatic conditions. They have done great things in the tropics of Malaya and the Dutch East Indies. They did valuable constructive work in the cold climate of Manchuria.

Yet in China, as in other parts of the earth, no one has revealed a comprehensive grasp of the resources of the country. Dr. Sun Yat-sen put forward some grandiose ideas that were disappointing on account of lack of data and technical advice. No one has planned the economic future of China. We know that there are great natural resources in the country, but we need exact data. And we want to know what can be done most efficiently in China, and in other countries, for the benefit of humanity. No one seems to be working towards that economic world order which is so obviously the goal of evolution. Yet much could be done in China if there were real co-operation to develop the natural resources of the country and to improve public health. But the people of the country must seek and accept co-operation.

Patriotism in China

Empires and civilizations in the past have risen only to fall. They will continue to rise and fall unless man strives to produce a science of corporate living on the earth. In these days of rapid communication it is impossible for any to remain people in isolation. It is only by the interchange of ideas and commodities that progress is possible. The spread of a knowledge of medicine and engineering work in China will produce a more healthy and a more prosperous nation.

There are certain facts that the leaders of public opinion in China must accept if they really have the welfare of China at heart. One of them is that for the efficient economic development of the country they must obtain the co-operation of Europeans. Others are that there are immense possibilities of improvement in public health matters and a rise in the general standard of life for the people in the country if they will encourage the practical work of

engineering and medical science in China. Everyone doing that type of work is a true patriot.

From time to time Chinese students tell me that they are so distressed by the sad state of their people that they would willingly die to remedy evils now existing in China. But I always tell them to live—and to live strenuously. I advise them to work on practical scientific subjects. I tell them of James Watt, and his life devoted to improving the steam engine; of Faraday, and his invention of the dynamo; and of Manson and his discovery that a certain type of mosquito carries malaria. And I explain that these men and their like did more for England and humanity than politicians and theorists. For the work of scientists is never wasted. There can be no doubt that thousands of young men and women in China are capable of doing valuable scientific work. The record of those who have competed in the Universities of Europe and America prove that. The experience of those of us in close contact with Chinese students convinces us of their ability in any intellectual work. These young people can help China, even if their practical work remains more obscure than is that of the pioneers in other countries.

The Wonderful Tropics

Science will transform China. In the tropics the doctor and the engineer have done wonders in recent years. What was formerly jungle is, in many places now agricultural land: the old malarial swamp has healthy inhabitants because the engineer drained it free of breeding places for mosquitoes. Medical services also has taught the inhabitants how to preserve their health. And again, always remember that "first wealth is health." That statement should be a slogan for young China and placed in a prominent position in every school.

Hongkong presents an object lesson for everyone as an example of what applied science can do.

Sir Patrick Manson, and other local doctors, at great sacrifice of their own time, founded the Hongkong College of Medicine in 1887 for the training of Chinese students in Western Medicine; up to 1907 one hundred students had been enrolled and of those thirty-one had passed out as licentiates. Dr. Sun Yat-sen was one of the first graduates of this College of Medicine which, in 1912, became merged into the University of Hongkong. Many years later, in the Great Hall of the University, Dr. Sun said that it was his experience in Hongkong that made him so eager to reform China.

In the Shing Mun Valley near Hongkong where Malaria flourished and where a Great Engineering undertaking to provide a water supply for Hongkong is in progress

If you read the early history of the occupation of the island of Hongkong by the British you will be appalled by the death-rate. There was a battalion of English soldiers that lost over the third of its strength each year in the "forties" of the last century. It is said that no white child born in Hongkong in the first ten years survived. Malaria and plague demanded, and took, a terrible toll of human life. Those who survived had a low human efficiency value, as is evidenced by the early records. The population could not have increased from about 5,000 in 1841, to nearly a million to-day, if great attention and a considerable amount of public money had not been devoted to health problems.

The Public Health and Sanitary Services of Hongkong have done an immense amount to make life, not only healthy, but pleasant in Hongkong. When Dr. Patrick Manson (then in Swatow, afterwards in Hongkong and London) discovered that it was a certain type of mosquito that caused malaria, he gave a wonderful gift of knowledge to mankind. The obvious thing to do was to make life impossible in habitable regions for that insect. It was shown that, for the life cycle of the mosquito, stagnant water was essential. Therefore it was obvious that if we eliminated stagnant water malaria would disappear.

Another scene in the Shing Mun Valley showing conditions that caused Malaria to flourish before the coming of the Engineers and Doctors

The War on Malaria at Shing Mun

No better example of the aid given to engineers in their work can be cited than that of the freeing from infectious disease of the area surrounding the construction of the Panama Canal not long ago. That region was notorious for yellow fever and malaria. Those diseases were eliminated by energetic scientists. In that work the officials of the Government of the United States set an example to the whole world. Until they acted the district had a terrible reputation for sickness. The previous efforts of De Lesseps to build a canal connecting the Pacific and Atlantic Oceans had caused an appalling death roll. It was infectious disease, not engineering difficulties, that defeated De Lesseps. The Government of the United States swept out the terrifying and

Showing Chinese dwellings in the Shing Mun Valley which were removed in the fight to Eradicate the Malaria Mosquito

death-dealing insects from the Panama Canal zone and made it safe for human habitation.

In Hongkong, to-day, there is a great engineering scheme being carried out in the Shing Mun Valley, some five miles from Kowloon, on the mainland. There, a number of engineers and numerous mechanics, coolies, etc., are building the seventeen million dollar dam for the storage of water. The sickness—mostly malaria—that has been experienced there has caused grave anxiety, not only to those actually concerned in the work, but to many other residents in Hongkong. Public opinion demands that such sickness should be reduced.

At a recent meeting of the Legislative Council, Sir Henry Pollock drew attention to this matter. The reply of Dr. Wellington, the (Government) Director of Medical and Sanitary Services is of great interest to those waging war on malaria. Engineers at work in the tropics will feel that his recommendations should be carried out.

It should be noted particularly that this medical expert, who had many years of experience in Malaya (where malaria is a great enemy of the inhabitants) stated that mosquitoes do not travel more than a half a mile from their breeding places. Of course, that might be a proven scientific fact for Malaya but not for other places. Indeed many people in Hongkong believe that these insects are carried much greater distances by strong winds.

Concerning the measures now being taken at Shing Mun, the remarks of Dr. Wellington, made at the meeting of the Hongkong Legislative Council, reveal some of the plans and methods employed. He said :—" The whole area surrounding the site for the Dam is broken country consisting of granite hills separated by steep sided valleys. At the date of commencement of operations the narrow inverts of these valleys were drained by boulder-bedded streams fed by innumerable seepages and springs. Wherever possible the hill sides had been terraced and irrigated for the wet cultivation of paddy. The country abounded with potential breeding places of anopheline mosquitoes, many of which were difficult to bring under control.

By mutual agreement it was early decided that there should be a division of labor in carrying out the scheme for malaria control. The Medical Department undertook responsibility for investigation and research for anti-larval measures other than drainage, for drug prophylaxis, and for treatment. The Engineering Staff undertook to do clearing and drainage, the construction of buildings and general sanitary requirements. It was understood that the two departments should work in full co-operation.

The Flight of Mosquitoes

All the privately owned land within a radius of half a mile from the lines had been acquired in order that there may be full control over this area. *In Malaya it was found that half a mile was beyond the normal flight of anophelines from their breeding places.* It is hoped that the same applies in Hongkong.

The Resident Medical Staff, all of whom are paid from Loan Account (for the water supply scheme), include one Chinese medical officer, two dressers and a gang of coolies. Two anti-malarial inspectors who are in training at the Malaria Bureau will shortly join the Resident Staff.

A small mosquito proof hospital of fourteen beds has been erected and in a few days time will be equipped and ready for occupation. A microscope has been provided. Mosquito-proof quarters for the medical officer and for the dressers have been completed.

Pending the completion of the hospital it was arranged that the travelling dispensary should visit three times a week and that a stock of drugs and dressings should be kept near the lines.

The Malariologist supervises the investigative and preventive side of the medical activities and the Medical Officer New Territories the curative work. Both officers visit bi-weekly.

Anti-malaria inspectors from the Malaria Bureau visit frequently for the purposes of collecting mosquitoes and their larvae. Specimens caught are conveyed to the Bureau for identification and dissection. During this year 25,000 anophelines caught in the lines have been identified and dissected. The infection rate varied from nil to 20 per cent according to the species and the season.

The Sick Rate at Shing Mun

The lines are visited daily and any sick found there are examined and treated. A statement of vital statistics is sent daily to medical headquarters and records are being kept.

The daily sick rate among the laborers so far as can be ascertained from a shifting population, is about 54 off duty owing to sickness.

From time to time blood tests have been made to ascertain the parasite rates of the various sections of the labor force. It has been found that a varying percentage of those engaged are already carrying the parasite when they take up residence.

The malaria situation at Shing Mun is a very difficult one to control owing to topographical and geological factors, the range of flight of malaria-carrying anophelines, and the constantly shifting population.

The prophylactic measures taken so far have been those directed against mosquitoes and their breeding places. The methods employed are oiling and paris green application by the medical staff, and clearing and drainage and mosquito proofing of lines by the engineering staff.

It is estimated that twelve miles of water channel are being oiled weekly, the amount of oil expended being 250 gallons. Certain areas are being treated with paris green diluted with dust.

The oiling gang consists of ten men under the supervision of a dresser.

Area dried by drainage operations 18 acres.
Length of subsoil piping 12,763 yards.
Length of open concrete channels 8,870 yards.

Clearing preparatory to oiling channels eight miles.

Number of labor force employed in clearing and draining 200.

Mosquito nets were supplied to the coolies, but, the infection rate remaining high from the mosquitoes found in the lines, it was decided to try and mosquito proof the lines themselves by providing wire screens for windows and doors. Work is in progress in this direction.

Drug prophylaxis has not been attempted owing to opposition on the part of the laborers and the difficulty of checking individuals under the contact system.

There is every reason to believe, however, that the activities of the medical staff and the engineering staff working in full co-operation will render the area salubrious and maintain a good state of health in the labor engaged.

The Doctors of China

During the century there has been good progress in medical work in China, but it needs a great deal of acceleration. Recently Dr. Wu Lien-teh addressed the Western-trained doctors in Hongkong. He recalled the ancient healers, such as the surgeon Hua To of the Han dynasty, who is said to have used anaesthetics and is believed to have performed difficult operations such as brain trepanning ; Chang Chung-ching, scholar and physician who wrote a manual on epidemics including typhoid fever ; Li Shih-ying who produced a Chinese Pharmacoepia, and many others.

Unfortunately Dr. Wu was forced to point out that for nearly 400 years the old knowledge remained stagnant. Instead of progress there was reaction. Instead of scientific research there was secrecy and chicanery.

It cannot be doubted that some of the old Chinese methods of treatment are worth retaining. For years a member of my family suffered terribly from sickness caused by Ningpo varnish poisoning. If she was several feet within range of the newly applied varnish she became ill for weeks. Many people—Europeans and Chinese—become victims to this infection. Lacquer poisoning is the same sort of thing. It seems to resemble the oak-ivy poisoning experienced in California.

We had almost every European doctor in Hongkong for advice. We sought advice from skin specialists in England. Finally, and after years of despair, we accepted the advice given years before by the Chinese amah. It was very simple ; it seemed crude ; but it was immediately effective. The amah told us to boil chicken's feathers into a " soup " and apply the fluid externally to the affected skin. Of course we thought all that was just " numbo jumbo." But in our despair, and after years of suffering, we tried it. The result was amazing and splendid. Before we tried it we said " Of course it is only Chinese superstition, but if we do boil the chicken feather soup it will be anti-septic." And so we found out that it is really very foolish to jump to conclusions. If only we had put the suggestion to the test years earlier ! But we were prejudiced and for our prejudice we were severely punished.

But even to-day we cannot understand why European medical experts have never investigated the causes and cures of this horrible Ningpo varnish poisoning. Surely there is plenty of opportunity to put the whole problem on a scientific basis. Let us hope that the Lester Trust, the Peking Union Medical College, or other research institutes, will give attention to this and other Chinese remedies.

The Chinese have brought dietetics to almost an exact science. They excel in the treatment of simple fevers. Much may be gained by a complete investigation of their practices. Superstitions and chicanery abound, but if the chaff is separated there will be found wheat of some value.

Public Health Vital

But when all has been discovered the main basis of health presevation in China will be the adoption of Western knowledge. In the splendid effort the Rockefeller Foundation have done wonderful work. It is impossible to praise too highly the efficiency of the organization which works under that Trust ; the splendid vision of the founder, or the patient and valuable work that has been accomplished. Engineers at work in uninhabited regions in all parts of the world will reap full benefit.

The greatest success that has been attained by Christian missionary work in China has been connected with hospitals and medical service. There has also been in recent years considerable interest taken by missionaries in industrial education and education in scientific subjects for children. It is worth remembering that some of the most successful missions ever established were those of the Jesuits in earlier times in South America. They established what were practically self-supporting communities of Indians, who carried out all the manufacturing and agricultural work necessary for their maintenance, establishing settlements of great beauty, and utility. They were ruthlessly destroyed by their own countrymen—Spaniards and Portuguese political rivals. But the more that we learn of the experiment the more certain it is that the Jesuits did splendid, and practical civilizing work in those South American forests.

The Great Advance

If Christian missionary work is to make progress in China that practice of teaching people how to live before teaching them how to die must be widely extended.

There is a need for a strong, virile science of industry-planning in China. The work must be carried out by engineers and economists under ethical principles, in the double interest of the Chinese producer and the foreign consumer. The attempt to foster Chinese arts, and to increase the self-supporting power of the people, is likely to appeal to the general intelligence of the average European in a manner that sectarian work alone must fail to do.

Our work on behalf of China must be inspired with this new spirit. We should regard the whole earth as a common heritage which needs a more planned and intensive organization of its potentialities. Perhaps in the past our labors and our ideals have lagged behind the tremendous advance in knowledge that has come to us out of the scientific progress of the power age. We are no longer dependent on muscular energy for work ; we have the gaint power of steam, the rushing waters that give us accessible and convenient electricity, the oil that makes transport by land, sea and air a simple matter. Surely the time has come for a conscientious and scientific stewardship. What more noble aim in life for a young Chinese than that of the doctor and engineer—to promote health and to raise in China the general standard of life ?

Let us therefore persuade our Chinese friends to give their sons an opportunity to acquire a sound scientific training. There are now many Universities and Colleges in China where facilities are offered. Post-graduate work for selected able workers can be arranged in Europe and America.

It is not only unnecessary but unwise, to send a youth direct from school to some foreign country. He can, and should, obtain the routine training needed to qualify for the profession of medicine or engineering in China. In the difficult years of youth he should be kept in touch with his own people. And there are now several efficient training centers in China. As far as is possible they should co-operate one with another.

It is also essential that doctors and engineers should co-operate in China. Much remains to be done to improve the standard of life, the health and the economic condition of the masses. It can only be accomplished by men trained in applied science.

Sulzer Marine Engines for Japan

The Toyo Kisen Kaisha has ordered three single screw ships from the Mitsubishi Dockyards, Nagasaki ; a six-cylinder Mitsubishi-Sulzer two-cycle engine of 4,000 b.h.p. will be installed in each vessel.

The Ishida has ordered from the same Dockyards a single-screw motorship propelled by a 4,000 b.h.p. Mitsubishi-Sulzer Diesel engine.

The Kokusai Kisen Kabushiki Kaisha has passed an order to the Harima Dockyard for a 9,000 ton motor passenger and cargo boat, which will be propelled by a 7,600 b.h.p. double-acting airless-injection Sulzer two-cycle Diesel engine built by the Kobe Steel Works.

The Mitsubishi firm has received an order from the same shipowners for two vessels, each of which will be propelled by a 7,600 b.h.p. Mitsubishi-Sulzer seven-cylinder two-cycle double-acting engine.

Railway Axle Plant for Russia*

An interesting plant for machining railway carriage and wagon axles on a vast scale has recently been constructed for export to Russia by Craven Brothers (Manchester), Ltd., Reddish, Stockport. This plant is designed to give an output of 270,000 axles per annum, and comprises four axle parting, ending, centring, and shouldering machines similar to that shown in Fig. 6, on this page : five roughing lathes, Fig. 7 : two finishing machines, Fig. 8, and four journal grinding machines, Fig. 1. The equipment of these machines embraces many features which have hitherto been mainly used on small automatic machines. These features have been included in order that the machines can be operated by semi-skilled or, possibly, by unskilled workpeople.

The double-ended, center-driven type of machine tool is specially suited to the machining of railway carriage and wagon axles, and it will be noted that a center-driven headstock is a feature common to all the machines illustrated. This type of drive for axle lathes is, of course, not new. Applied to machines having multiple tooling and semi-automatic tool slide operation it gives a greatly increased output. The design of the machines has also been influenced by the intention to make use of cemented tungsten carbide cutting tools, which necessitated great strength and rigidity of the parts, and the use of ball and roller bearings and pressure oiling systems to allow of high speeds and maintenance of accuracy of alignment.

Parting, Ending, Centering and Shouldering Machine

The parting, ending, centering, and shouldering machine illustrated in Fig. 6 performs the preliminary operations before the axles are placed in the roughing lathe, and although these operations appear at first sight to be simple enough, they involve the use of a number of tools —see Fig. 2. There are the front and rear parting tools at each end and the tools for cutting out the radiused portion of the journal, mainly to assist in the subsequent

**The Engineer*

Fig. 6.—Axle Parting, Ending, Centering and Shouldering Machine

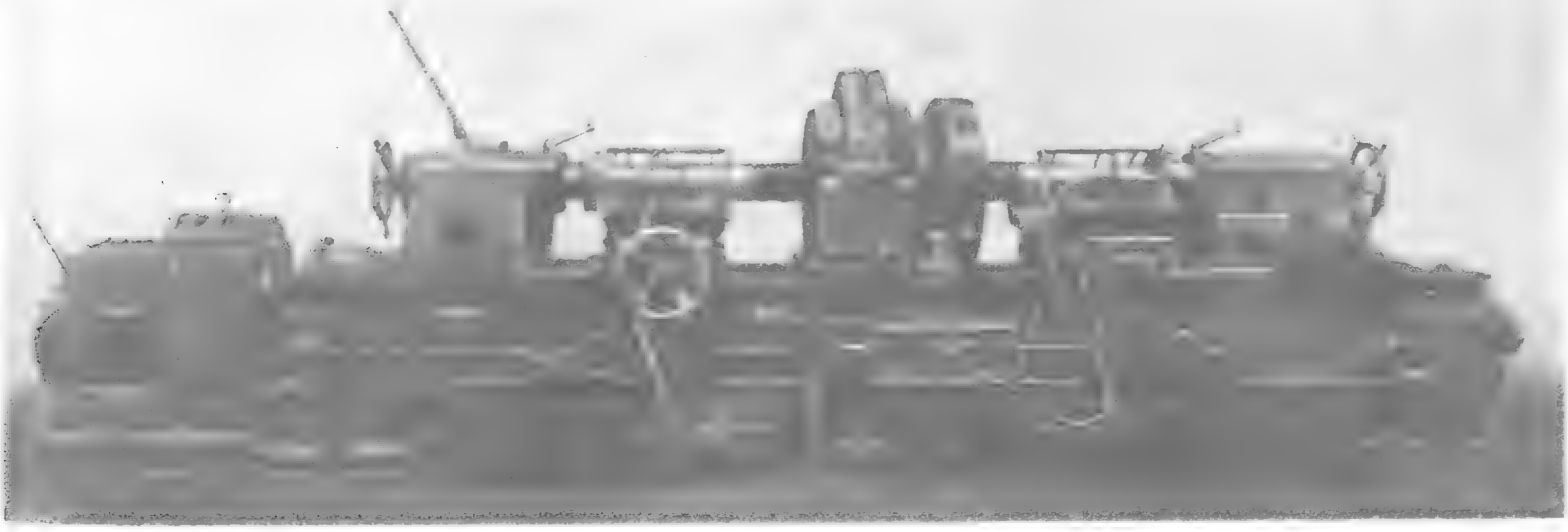


Fig. 7.—Axle Roughing Lathe with 60 h.p. Motor

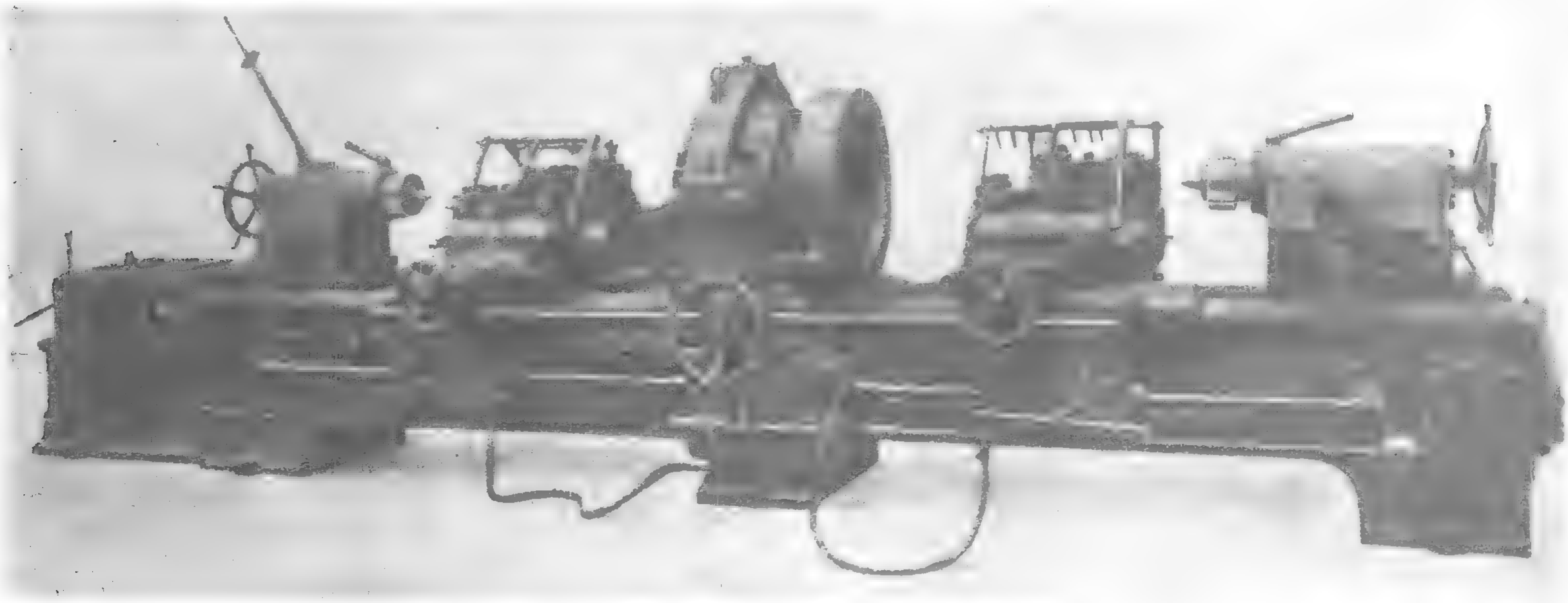


Fig. 8.—Axle Finishing Lathe with 20 h.p. Motor

machining operations. The operations of drilling and centring the axle are then performed automatically. The sequence of the operations carried out on this machine is as follows :—The axle, being placed in the centre V support, the headstocks with their slides are traversed quickly along the bed, bringing the cutting tools to the correct position for parting the axle. The control for these heads and slide traverse is by means of push-buttons, and the operation of placing the axle on the V supports and adjusting the heads is carried out in approximately two minutes. The jaws of the concentric chucks are then tightened on to the axle also by means of push-buttons.

After the axle has been gripped at both ends, a lever centrally placed on the lathe is moved to the starting position, which immediately sets the machine in motion and causes the front and rear tool slides to approach the axle rapidly, after which the feed is automatically engaged. While the ends of the axle are being parted the grooving tools on the front slide are also engaged. These have a traverse of about an inch during the cutting operation, after which they automatically return to the starting position whilst the parting tools continue to traverse. On the completion of the cutting operation the pieces cut from the axle fall into trays provided for the purpose, the tool slides returning automatically to their starting position. It should here be mentioned that during the cutting operation the speed of cutting automatically increases as the tools approach the center of the work, and during the quick return of the slides the speed automatically changes to the low or starting speed. The main spindle is then stopped by a push-button and the drilling heads, which are also controlled by push-buttons, are set in motion. There are three spindles in a circular form of turret to each tool slide, the first being provided with a cutter which removes the pip left on the axle from the parting operation. This provides the center for the second spindle which performs the high-speed drilling operation. When the drilling is complete the coning drill spindle comes into operation, finishing the complete center at both ends of the axle. The drill heads are fed and indexed automatically and when the centering operation is complete they stop automatically.

The axle is then ready to be released. The chucks are opened by push-buttons, and the headstocks and slides are traversed towards the ends of the bed to enable the axle to be lifted clear. The complete series of operations is effected in eight minutes without any heavy manual effort. There are six electric motors on the lathe, together with the necessary switchgear and control system, and the push-buttons and main control lever are centrally placed for easy access. Fig. 3 shows the controlling mechanism for the automatic operation of the tool slides and the speed change mechanism. It may be mentioned that where it is necessary to use A.C. constant-speed motors, the changes of speed are obtained by friction clutches, but where D.C. supply is available the variations in speed are obtained from a variable-speed motor, the change being adjusted electrically. In both cases the speed changes are controlled automatically by the position of the tool slides. This lathe weighs 19½ tons.

Axle Roughing Lathe

The axle roughing lathe on which the next series of operations is performed is shown in Fig. 7, and its tool equipment in Fig. 4. The duty of this lathe is to rough turn the journals and wheel seat portion of the axle. The grooves machined during the preliminary operation greatly assist in the adjustment of the tools for depth, so that the longitudinal traverse can start immediately. This lathe is of the semi-automatic type, the tool slide and saddle movements being both automatically controlled from the central control mechanism. Thus when the axle is in position in the machine a lever is moved which causes the tool slides to approach the axle quickly, after which the longitudinal control lever is operated and both saddles and their tools are traversed lengthwise along the axle, turning the various diameters simultaneously. Upon completion of the cut the saddles return to their starting position automatically and the tool slides are rapidly withdrawn

Fig. 1.—Double-Ended Grinding Machine

from the axle. The tools are all controlled from one central position.

The center driving spindle is mounted on ball bearings, and the drive from the spindle to the axle consists of a floating type of driver which automatically takes up engagement. The right-hand tail-stock is mounted on a transverse slide, which is provided to enable the axle to be readily passed through the center head-stock spindle to its correct position. The movement of the tail-stock on its slide is controlled by a push-button for rapid adjustment. The tail-stocks are provided with special live centers of heavy design, and the spindle speeds provided enable either ordinary high-speed steel or tungsten carbide tools to be used. The tools are supplied with coolant and all cuttings fall clear into trays below the bed. The main drive is taken by a 60 h.p. motor, and the machine is capable of performing all its turning operations on a 7-in. axle in ten minutes "floor to floor" time. Its weight is 14½ tons.

Fig. 3.—Tool Slide and Automatic Controls on Parting Machine

Axle Finishing Machines

The finish turning operations are performed on the lathe shown in Fig. 8, which is very similar in design to the roughing lathe, except that it has rear tool slides which are automatically operated and are arranged with tools for accurately finishing the shoulders and radii, as seen in Fig. 5. As these tools are never disturbed after being once set up, the accuracy of the various shoulder positions is maintained. The front saddles, provided with tungsten carbide tools for finishing cuts, are entirely independent of the rear in-cutting slides. When once the axle is placed in position and the driver is adjusted the tools are advanced forward to the correct cutting diameter, and the longitudinal feed is engaged. In both saddles this motion is controlled by one lever. A very high cutting speed is obtainable for the use of alloy tools. When the traverse is completed the slides automatically return to the starting position, at which point the operator engages the rear tool traverse mechanism, which causes the tools to approach the axle quickly and automatically, and when the correct depth is attained the feed is automatically engaged. To enable high speed forming tools to be used on the machine after using tungsten carbide tools for the turning operation the speed is automatically reduced, thus mitigating the possibility of damaging the tools by the use of the wrong speeds. When the rear tool-cutting operations are completed the tool slides return automatically to their starting position, during which time the spindle speed is again automatically changed back ready for the first operation. The complete range of operations on this lathe occupies 15 minutes. The machine is driven by a 20 h.p. motor and weighs 12¾ tons.

(Continued on page 570)

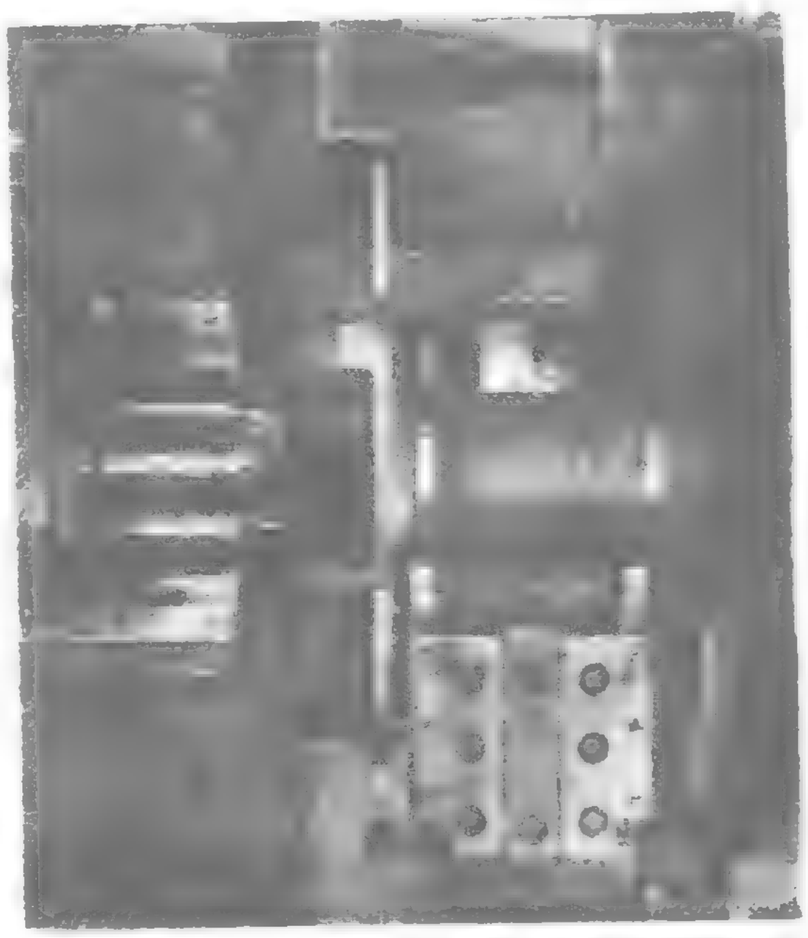


Fig. 2.—Tool Lay-Out on Axle Parting Machine

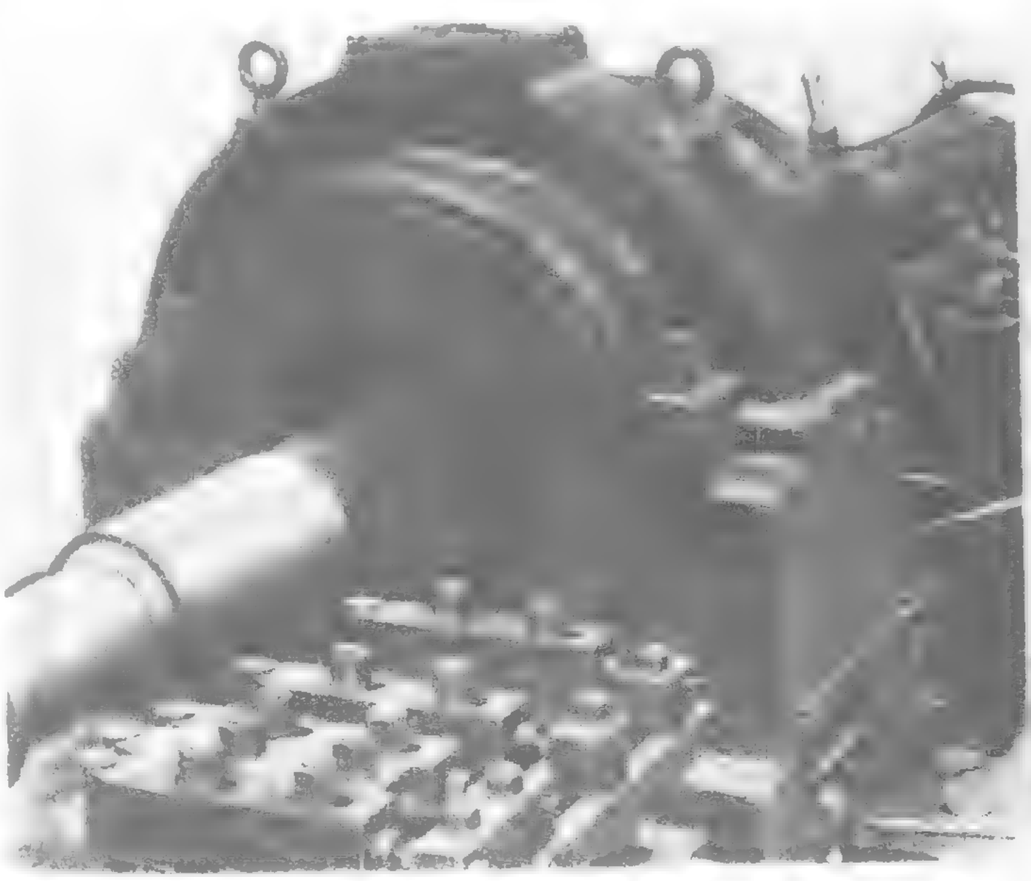


Fig. 4.—Tool Lay-Out of Roughing Lathe

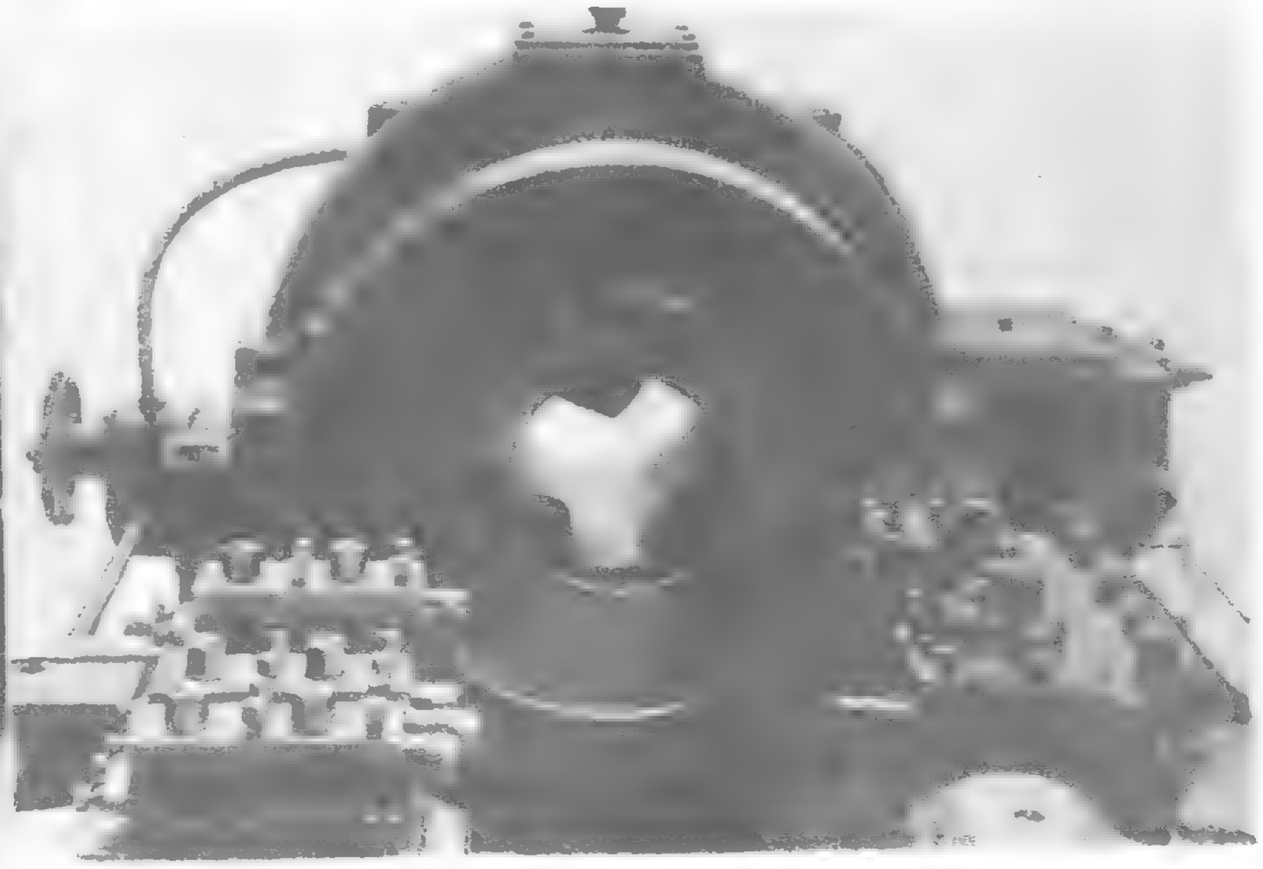


Fig. 5.—Tool Lay-Out of Finishing Lathe

Streamlined Diesel Electric High-Speed Trains

TRANSPORT services are particularly hard hit by the present depression in trade. Also the railways see themselves compelled to adopt every possible method which may effect an improvement in service results. In the first place, an endeavor is made to rationalize the service, i.e., to reduce working costs. In many places it is already recognized that the adoption of Diesel traction is an excellent means of attaining this end. Means must be sought to counteract the continuous diminution in income, at least in so far as regards the loss of passengers and goods traffic to other methods of transport. Here also Diesel vehicles, and particularly rail cars, can render valuable service, since they allow the time table to be improved in the most rational possible manner by increasing the number of trains run, thus making it possible to attract back to the railway a considerable percentage of the passenger traffic previously taken away by the motor-cars.

Only during the last few years has it been more and more recognized that the strength of a railway in competition with the motor-car lies principally in the possibility of considerably increasing the travelling speed being possible. With a motor-car an average speed of about 50 km. (30 miles) an hour can be reached in a hilly district, whilst the overland omnibuses stopping once about every 4 km. have an average travelling speed of only about 35 km. an hour. On the railway, local trains stopping at similar distances apart could have their speeds increased at present by 30-50 per cent by adopting rail car service. In express train service the saving in time as compared with an omnibus is considerable, although it is not so great as compared with a private motor-car which is not bound to stop regularly at certain places. Nevertheless the average speeds mentioned above could not be maintained by a motor-car over distances exceeding about 125 miles, since a road journey of several hours is considerably more tiring than one in an express train, in which also in hilly districts an average travelling speed of about 60 km. an hour can be reached with stops averaging about 30-40 km. apart. Over a distance of about 250 km. the time saved by travelling in an express train amounts to about 1½ hours.

In level country the average speeds of both motor-cars and trains are higher, but the ratio between the time of travelling by the two systems nevertheless remains much the same. But during the last few years conditions have become very much worse for the railways in certain districts because of the construction of special roads for motor-car traffic. By adopting bypass roads round towns and villages, avoiding sharp curves, and abolishing all level crossings, the speed of the motor-car traffic can be considerably increased. Also the competition of the airways must not be left out of account, so that it is necessary to study the possibility of considerably increasing the speed of express trains. By introducing automatic signalling at the stations, using more favorable curves on the line, and strengthening bridges, it has been found possible to increase the travelling speed considerably in the course of recent years, without having to increase the maximum speed. The maximum speed of express trains has hardly changed in most countries during the last 40 years, but improvements have been introduced which enable express trains to-day to maintain their maximum possible speed over nearly the whole line, whilst formerly it could be reached only over short distances. Nowadays, however, the only possibility of further decreasing the time required for a journey is to increase the maximum speed. On lines with many curves, in a hilly district, great difficulties will be encountered in making the lines suitable for high-speed traffic, since the expense of increasing the radius of curves would be far too great.

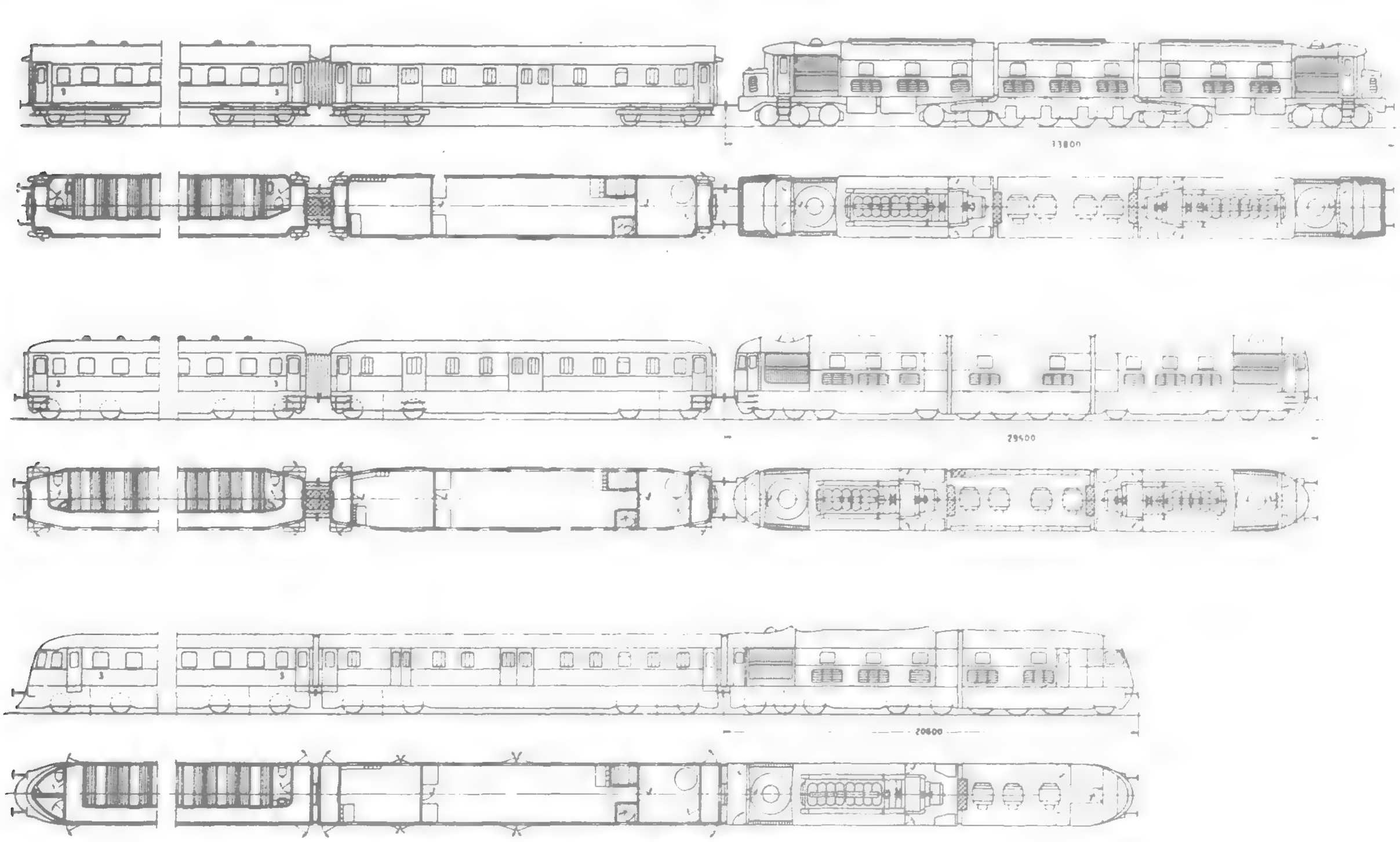


Fig. 1.—High-speed trains with Diesel-electric locomotives

V max=130 km. per hour

Variant 1, 3,900 h.p.; Variant 2, 3,000 h.p.; Variant 3, 2,309 h.p.

Variant 1: Train weight, including locomotive, 600 tons

Variant 2: Train weight, including locomotive, 560 tons

Variant 3: Train weight, including locomotive, 510 tons

About Air Resistance

Also in flat districts, considerations of economy prevent the maximum speed being increased, although in such country the curves there could be modified at comparatively little cost to suit high speeds. The sole reason of the change being uneconomical is that the air resistance rapidly increases with increase in speed, thus making running expenses much higher. If, for example, it is desired to raise the speed from 100 to 150 km. per hour, the air resistance will be increased by about 125 per cent. At 100 km. per hour the air resistance, for a train composed of a locomotive of the usual shape hitherto employed and hauling a certain number of carriages, is responsible for about two-thirds of the total train resistance, so that at a speed of about 150 km. per hour the total resistance would be nearly doubled. The power of the locomotive must be increased to a still greater degree, since its weight also increases and the energy or the fuel required for hauling a certain weight of train would then have to be multiplied by 2.2 to 2.5.

Such an increase in the cost of hauling a train cannot be contemplated if an endeavor has to be made to rationalize the service by reducing expenses. Nevertheless it must be observed that this circumstance does not play such an important part in Diesel service, since the expenditure for fuel and water is in this case only about $\frac{1}{4}$ to $\frac{1}{3}$ of the expenditure for steam traction; in addition, these high speeds allow the Diesel locomotive to travel a far greater distance per annum, so that the higher cost of acquiring it does not so greatly affect the costs per mile run.

Attempts were made some years ago to apply to traction vehicles the same principles employed in aeroplanes in order to diminish air resistance.

Recently it has been found possible to construct rail cars of such a shape that the air resistance, when running in either direction, can now be reduced to a third of what it was with cars of the old design. Several types of such cars are already in service in several countries, and the development of such vehicles can now be considered as completed to a certain degree. It will, however, also be necessary to devote much attention to designing complete express trains of streamline construction. There are various reasons for this:

In the first place, it must not be assumed that the conditions prevailing during the present crisis will last for ever, it must be assumed that traffic will again increase to what it was in the years 1927-1929.

Other Comparisons

Express traffic will probably be important particularly between large industrial and business centers 200 to 300 km. apart, since for shorter distances the advantage over the motor-car is too small. Competition from aeroplanes does not come seriously into consideration at such distances, since too much time is lost at the start and finish of the flight in journeying between the aerodromes and the towns. For greater distances, however, a certain part of the public who desire to save as much time as possible will prefer to travel by air. But if the distance between such towns can be traversed in 2-2½ hours, all business men, who possibly constitute 70 per cent of the passengers, will wish to make the journey out in the early part of the day and to return home in the evening. Consequently there will be a well-filled early train in each direction in the morning and other similar trains in the evening, whilst in the interval there will be no great demand for express service.

Another example for the adoption of express service is in connecting the principal European towns with the ports. But here also all passengers arriving or departing with one ship will wish to travel in the same train, so that in this case a large train will be the most suitable solution.

One important advantage of the railway train over the aeroplane is that a traveller in a train has more freedom of movement. This advantage will possibly be still further increased by the European railways by following the example of the Americans in introducing reading rooms, observation cars, etc. This, however, necessitates a larger train.

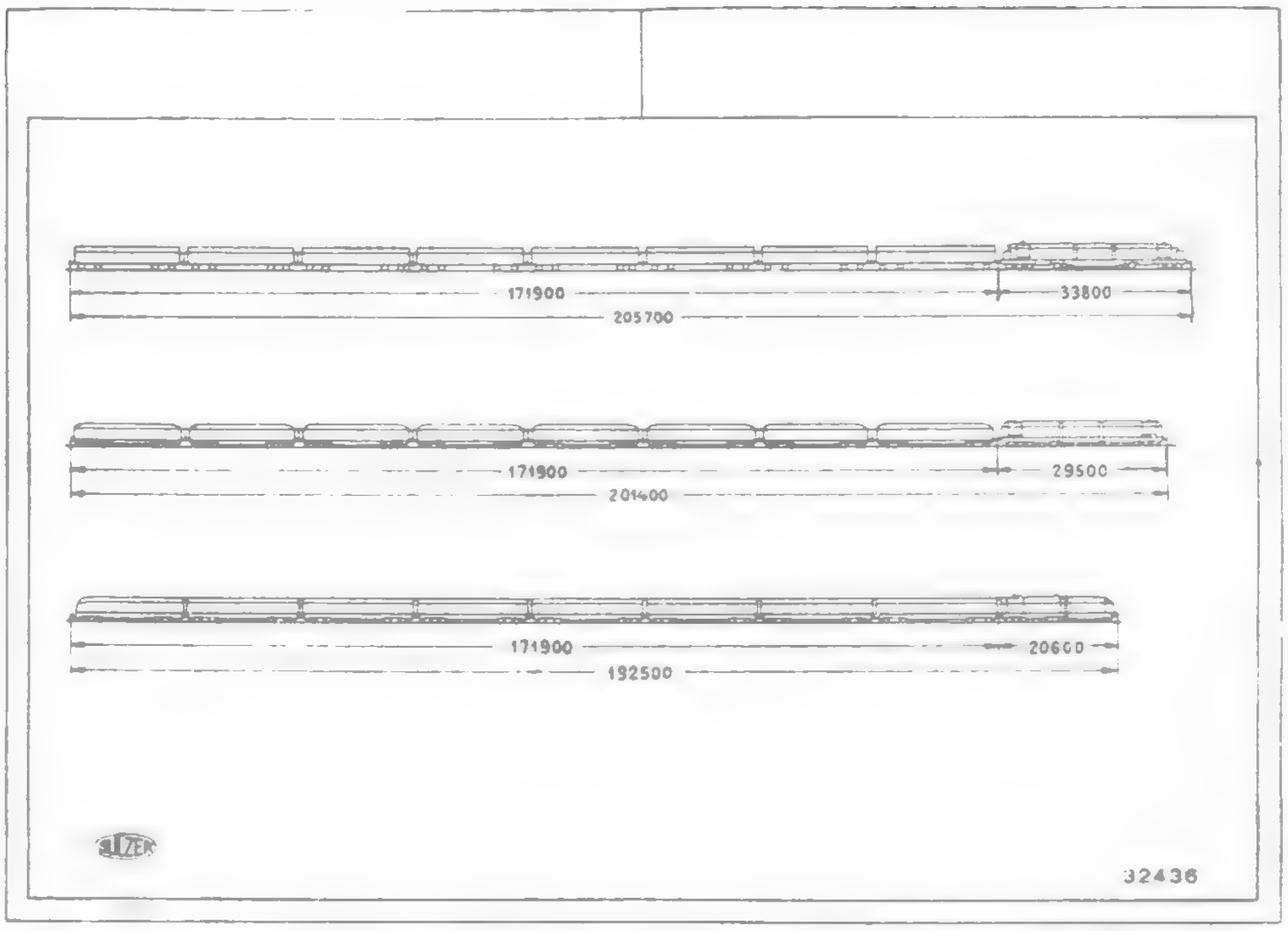


Fig. 2.—Express trains with Diesel-electric locomotives for a maximum speed of 130 km. per hour.

Sulzer Brothers have occupied themselves not only with the problem of high-speed rail cars, but also with the development of locomotives for high speeds. In connection with the development of special types of locomotives it is also necessary to depart entirely from the usual type of carriages for an express train.

Figs. 1 and 2 show three trains with practically the same accommodation and designed for the same speed, 80 miles per hour. The first variant shows a train of the construction hitherto usual, the second variant a train of somewhat improved shape, and the third variant a train ideally streamlined as far as is practically possible.

The fundamental principles taken into consideration are the following. In variant 2, the locomotive and all the trailers, and particularly the end carriage, can run in either direction. The shape of the ends of the locomotive and cars are, however, better than in the usual form of construction. The end and side walls are extended downwards below the frame in order to cover the wheels, bogies, etc.

Variant 3 is a train of fixed composition intended to run in only one direction. Consequently, at terminals it will be necessary to turn the whole train round by a loop or cusp, or to shunt the locomotive and end car. In the United States this is necessary in the case of every Pullman train with observation platforms, and is not found to be a great disadvantage. It is then possible to stream line the front of the locomotive and the end of the last car, and in spite of that to keep the distance between the locomotive and the first car and also the distance between the separate cars very short. The length of the cars over the buffers is the same as in variants 1 and 2: the distance between the buffer beams is also the same, so that standard drawbar and buffer mechanisms may be adopted. The side walls, however, are extended beyond the buffer beams and the sides of the gangway bellows are brought out into the same plane as the side walls, thus not only greatly retaining the air resistance but also slightly increasing the accommodation of the cars. Instead of roof ventilation of the usual type, artificial ventilation is adopted, in conjunction whenever possible with an air conditioning plant. Naturally every precaution is taken to avoid unnecessary projecting parts, the roof and walls being designed to be as smooth as possible.

Results of Tests

Results of the measurement of air resistance of complete trains have been published hitherto, as far as we know, only in the transactions of the A.S.M.E. of September 30, 1932, page 235. These tests were carried out in a wind tunnel, and certainly do not give an exact representation of the actual conditions in service, but they at least yield data from which the various constructional forms can be compared.

For the air resistance the formula adopted is :

$$\text{air resistance} = c\frac{\gamma}{2g} A_1 V^2$$

where

V = train speed in ft./sec.
A_1 = projection of the cross-section of the train on a plane normal to the direction of running, in sq. ft.
c = coefficient of resistance of the train, a figure without dimensions.
γ = specific gravity of the air in lb/cub. ft.
g = acceleration due to gravity, 32.2-ft./sec./sec.

The coefficient of resistance was determined by experiment for trains of normal and of streamline construction, the values being determined for the locomotive alone and also for trains with different numbers of trailers.

The results of these experiments must be accepted with caution for the following reasons :

The eddying occurring between the cars and the ground could not be determined in the wind tunnel.

The roughness of surface of the walls has, as mentioned in the publication, a great influence on the measured results. In service this factor will play a considerably smaller part. It will not be possible to determine the proper scale of model from theoretical considerations. The influence of side wind was not investigated in these tests.

Further, the results of the tests cannot be at once applied to the trains shown in fig. 1, since in the American tests the back of the locomotive or of the last car is in a vertical plane, whilst in our proposal a good streamline form for the rear car is considered of great importance.

Fig. 3 is a reproduction of fig. 8 of the A.S.M.E. publication. To the left is shown the coefficient of air resistance of a locomotive or of trains with one to six cars of present-type build ; to the right is the coefficient for streamlined locomotives and trains. Fig. 4, which gives the coefficient of air resistance for trains according to variants 1, 2 and 3 in figs. 1 and 2, is based on fig. 3 from the following considerations.

Although there are certain differences between a train constructed as shown in variant 1 and the train of the conventional present-day type, the same resistance has been assumed for variant 1. Variant 2 is somewhat more unfavorable in shape than the American streamlined train, since in the latter the connections between the separate cars are smooth. The air resistance of a train constructed according to variant 2 lies accordingly between the air resistance of variant 1 and that of the American streamlined train. For variant 3, the air resistance must be less than for the American streamlined train, because the improved streamlined shape of the last car reduces the resistance. The air resistance of the locomotive alone is therefore assumed to be the same as in the American tests, whilst that of the train with one to eight coaches is reduced by a certain amount.

In order to show how the savings in power per unit weight, which are rendered possible by introduction of streamlined construction, increase with increasing speed, the weights and power required for the three variants of figs. 1 and 2 are given in table 1 for 130 km. per hour and also for 110 and 150 km. per hour.

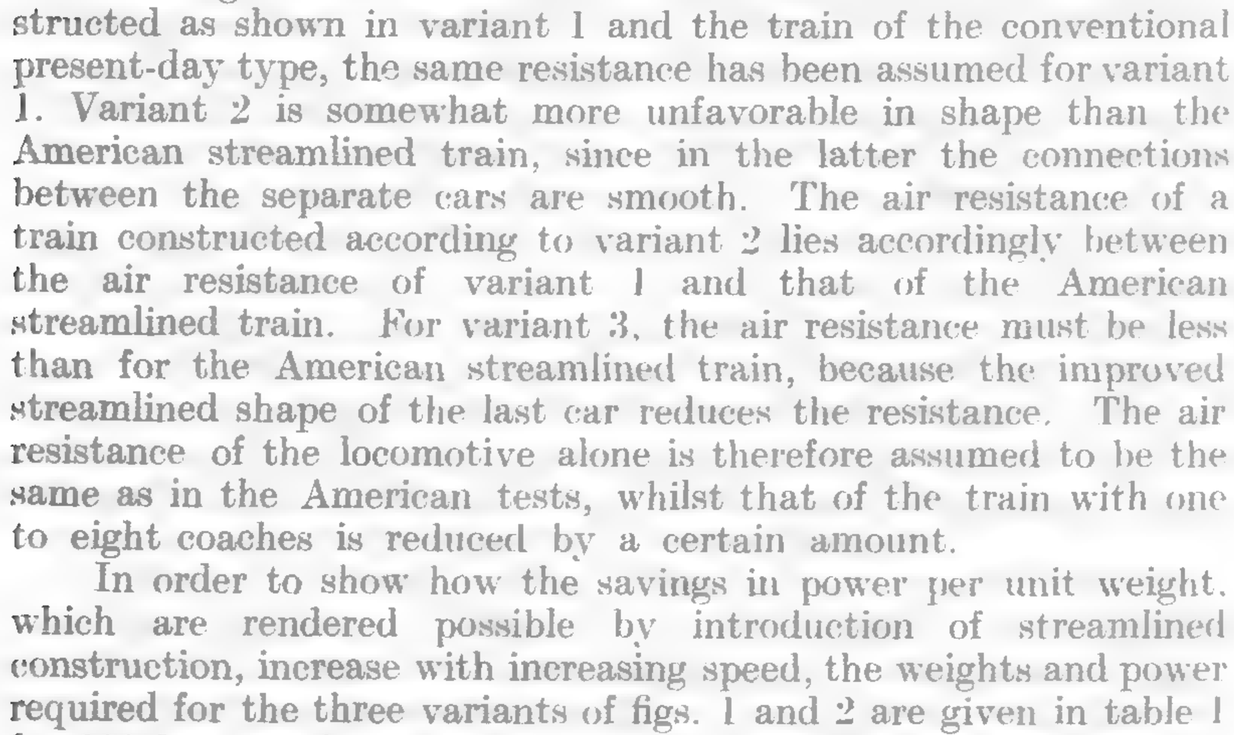


Fig. 4.—Coefficients of air resistance for trains constructed according to Figs. 1 and 2.

TABLE 1

	Variant 1	*Variant 2*	*Variant 3*
V_{max} = 110 km/h. Trailer weight metric tons . .	360	360	360
Locomotive weight metric tons . .	177	153	120
Total weight metric tons . .	537	513	480
Diesel engine output h.p. . .	2,600	2,100	1,700
V_{max} = 130 km/h.			
Trailer weight metric tons . .	360	360	360
Locomotive weight metric tons . .	240	200	150
Total weight metric tons . .	600	560	510
Diesel engine output h.p. . .	3,900	3,000	2,300
V_{max} = 150 km/h.			
Trailer weight metric tons . .	360	360	360
Locomotive weight metric tons . .	310	250	190
Total weight metric tons . .	670	610	550
Diesel engine output h.p. . .	5,600	4,100	3,100

It might be thought that the streamlined trains with their low power per unit weight would lose too much time when starting. In order to clear up this point, the starting time required for acceleration for the three variants up to 150 km. per hour has been calculated. Table 2 contains these figures, and also the time required by all variants for passing over the distance which the streamlined train, variant 3, requires to reach a speed of 150 km. per hour. The table shows that the differences in time are very slight.

TABLE 2

	From start to 150 km/h		
	Variant 1	*Variant 2*	*Variant 3*
Starting distance m.	11,300	13,400	15,600
Starting time sec.	375	443	520
Final acceleration at 150 km/h m/sec.^{2}	0.02	0.02	0.02
Time for 15,600 m. sec.	478	496	520

The Factor of Economy

The factor which absolutely determines the practical value of the streamlined train is economy. There is no interest in comparing trains of the present-day type with a streamlined train for the same speed of 110 or 150 km. per hour, since at 110 km. per hour it must at once be evident that introduction of the complications of the streamlined train would not pay, and that, at 150 km. per hour, a train of the present-day type would be so uneconomical in service that its adoption to run according to time table would appear to be practically impossible. The calculations regarding economy will therefore be confined to comparing trains of variants 1 and 3 at 130 km. per hour, and a train of variant 1 at 110 km. per hour with a train of variant 3 at 150 km. per hour, in order to show how much more economical a streamlined train is at a given maximum speed, and also, with working expenses approximately the same, that the travelling speed can be increased by 35 per cent by introducing the streamlined type of construction.

(*a*) *Comparison of trains with maximum speed of 130 km. per hour.*

The time table for both trains is practically the same, since the difference in the time of starting may be neglected over long distances. The cost of the train staff for a certain distance is also the same. In both

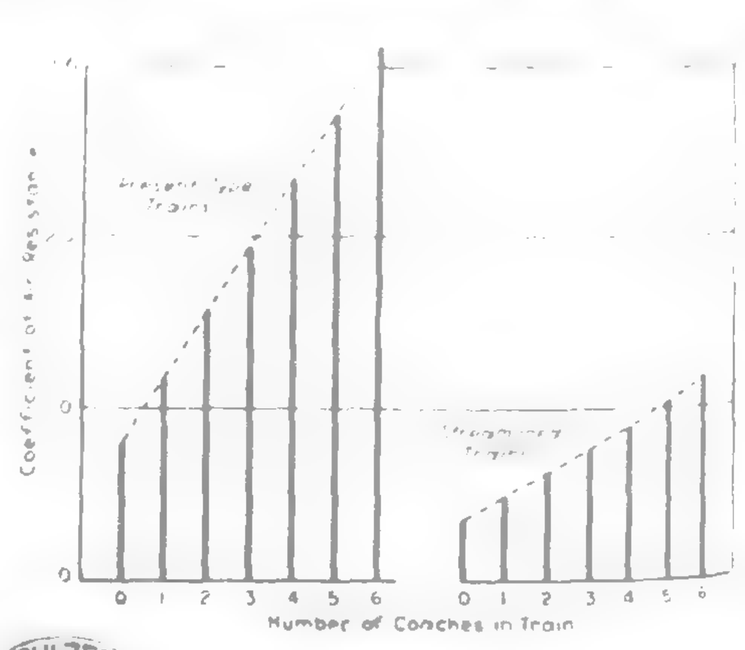


Fig. 3.—Coefficients of air resistance for trains according to American tests. Coefficient of air resistance. Number of coaches

cases the locomotives run the same number of kilometers per annum ; the amounts required for interest and depreciation per kilometer are therefore in the same proportion as the prices of the locomotive. The cost of the carriages composing the train may be assumed to be the same for both variants. The cost of the streamlined coaches is increased by extending the sidewalls downwards and fitting the ventilating equipment, whilst on the other hand the cost can be reduced by simplifying the entrance platforms and the windows, which do not need to be then constructed so that they may be opened by the passengers ; keeping the windows open while the train is running would cause the air resistance to be unduly increased. Table 3 does not give a complete list of working costs, but only the items which vary according to the type of train. The calculation is based on the following data :

Price of the 3,900 h.p. locomotive of variant 1 .. Fr. 900,000
Price of the 2,300 h.p. locomotive of variant 2 580,000

Annual distance run. 150,000 km. Interest and depreciation together 8 per cent. Price of fuel Fr. 85 per metric ton. Price of lubricating oil Fr. 1 per kg.

TABLE 3

	Service costs in Fr./km. *Variant 1*	*Variant 3*
Interest and depreciation.	0.48	0.31
Fuel	0.40	0.20
Lubricating oil	0.07	0.04
Total	0.95	0.55

Saving in favor of the streamlined train Fr. 0.40, i.e. about Fr. 60,000 annually per train.

(*b*) *Comparison of a train of ordinary construction at 110 km. per hour with a streamlined train at 150 km. per hour.*

The travelling speed of the streamlined train is about 30 per cent higher than that of the ordinary train. The staff of the train and the locomotive are consequently better utilized, i.e. the amount required for wages, interest and depreciation per kilometer is lower. The various savings are shown in table 4. In addition to the data for table 3, the following assumptions have been made for table 4 :

Wages of locomotive staff	Fr. 22.00 per day
Distance traversed by locomotive staff per day on a train with 110 km. per hour maximum speed	450 km.
on a train with 150 km. per hour..	520 km.
Price of locomotive	Fr. 670,000 for 2,600 h.p. Fr. 740,000 for 3,100 h.p.

TABLE 4

	Working costs in Fr./km. *Variant 1 (110 km/h.)*	*Variant 3 (150 km/h.)*
Staff	0.05	0.04
Interest and depreciation.	0.41	0.35
Fuel	0.30	0.24
Lubricating oil	0.06	0.04
Total	0.82	0.67

Saving in favor of the streamlined train Fr. 15.

In as far as expenses which can be determined by calculation are concerned, the service with the streamlined train is cheaper here also, in spite of the considerably higher speed. Although the cost of maintenance of the Diesel engine per mile in the streamlined train is less, it must be assumed that the cost of maintenance of the running gear of the locomotive and coaches will be higher with the higher speed, so that the total costs for the two trains here under comparison will probably be about the same.

To sum up, it may be said that it is absolutely necessary at present to increase the maximum speed of trains in consequence of competition from motor-cars and aeroplanes. With small railway companies, and on the less frequented lines of large companies, as well as at hours when there is little traffic on the main lines, the rail car probably represents the best solution for dealing with traffic ; but it is to be assumed that locomotives will still be required for hauling trains in express service for economical and technical reasons, and will consequently be probably retained to a greater extent than rail cars. Comparative calculations concerning economy show that any considerable increase in speed is only possible if the shape of the locomotive and coaches are radically changed in conformity with the laws of streamlining in accordance with the minimum air resistance. In this way the maximum travelling speed may be raised from 110 to 150 km. per hour without increasing the cost of hauling the train. The adoption of Diesel locomotives is particularly advantageous for such trains. The higher the speed, the lower is the percentage per mile required for interest and depreciation, and the higher the percentage of expenditure for fuel of the running costs. The high price of the Diesel locomotive consequently comes little into consideration here, while the low costs for fuel are extremely important. The fact that Diesel locomotives consume no water and very little fuel is particularly advantageous with such service, since the locomotives can run long distances without having to take in more fuel or water.

From what has been said, it can be seen that the cost of acquiring a locomotive for a streamlined train is considerably lower than the cost of a locomotive for a train of conventional construction, at least as long as no heavy gradients have to be considered. If the gradients are so heavy that the speed on them falls below 100 km. an hour, the power of the locomotive must be determined in the first place by the gradients. In level country the streamline construction has always the advantage of lower fuel consumption and of shorter time required for starting.

Huai River Outlet

In connection with the application of the Huai River Conservancy Board for a loan of £400,000 from the British Boxer Indemnity Refund for completion of the first stage of its program, a party of engineers has left for northern Kiangsu for an inspection of the area. The first stage of the program consists of the construction of adjustable sluices at Chiangpo, water-locks at Huaiyin and Shaopo.)along the Grand Canal, as well as general adjustment of the course of the upper and lower reaches of the Huai River. The plan is to direct the waters of the Huai River to the sea through the abandoned course of the Yellow River in northern Kiangsu. The engineering work is so extensive that it has to be executed in stages. The estimated cost of the first stage is $30,000,000. The use of irrigation and navigation works is $20,000,000, and or providing a new flood channel to the sea $35,000,000, a grand total of $85,000,000. After the completion of the primary works, the land which is to be relieved from floods is 50,000,000 mow. Land which is to be reclaimed totals 1,500,000 mow, and that which is to be well irrigated is 40,000,000 mow.

Japanese Industrial Plans

The establishment of the Taiwan Paper Business Co. in Formosa has been realized, capital Y.1,000,000. Formal establishment was to take place July 1. This concern will manufacture paper from sugar cane.

Negotiations for the merger of two of Japan's three large brewing companies have been completed. The concerns are the Dai Nippon and the Beer Kosen Companies.

Negotiations have been concluded between the Daido Electric Power Co. for converting Y.25,000,000 loans into debentures.

The Hiroshima Gas Co. has arranged for flotation of Y.2,000,000 debentures.

The Iwaki Portland Cement Co. has entered into an agreement for flotation of Y.7,000,000 debentures.

The Daido Electric Power Co., one of Japan's "Big Five" power concerns, has decided to dispose of eight affiliated firms in the next two years. Daido Power has declared no dividend in order to counteract the heavy burden on its foreign borrowings of the exchange rate drop.

The Kawasaki family of Tokyo has decided to sell all its shares in the Ikegami Electric Trolley Co., Tokyo. The sale is regarded as preliminary to a merger of the Ikegami Trolley and Meguro-Kamata Trolley.—*Eastern Engineering and Commerce.*

China's Timber Supply*

It seems to be quite generally believed, though perhaps not fully confirmed, that much of those portions of China which are densely populated, and in which no natural forests exist, were once heavily timbered. Whether this be true or not, it is certain that at one time, timber was much more plentiful, and better distributed than now, and what is of greater importance, we know that re-forestation is both possible and economically practicable. The status of agriculture in the eastern and southern sections is such that lands suitable for farming can not be released for the growing of trees but, most fortunately, trees may be grown on the hillsides which are now uncultivated. By utilizing these practically waste lands, a timber supply can be created which will do much toward restoring a more favorable balance of trade.

While it is known that the native pine leaves much to be desired as a source of structural timbers, it is also known that it will thrive over a wide range of the country, it matures rapidly, it will do well on all but the steepest of mountain slopes, and it will serve many useful purposes. For these, and other reasons, efforts should be concentrated, for the present, on this variety, though not to the neglect of other useful native woods and of special varieties which may be introduced from other countries. In attempting to find a substitute for the native pine, a special effort should be made to secure a variety of pine which will have greater strength, larger and straighter trunks, and better resistance to decay. It is also desirable that the texture of the wood be such that it will take up preservative materials readily.

One of the most valuable pines grown in the U.S.A. is the Long Leaf Southern Pine which is found in a latitude corresponding to that of Chekiang Province. If this variety will thrive in China, its introduction should be undertaken, though even if it should prove readily adaptable, it should not be depended on entirely as it is of comparatively slow growth. It is exceptionally valuable for heavy construction as its strength is nearly equal to that of white oak; it grows to a great height, without branches; and the heart wood resists decay to a remarkable degree.

Of perhaps even greater immediate concern than the creation of new sources of supply, is the conservation of existing supplies and of timbers which, for at least another generation, necessarily will be imported from other countries.

In practically all other countries in which timber is used extensively, efforts have been made to extend the life of wooden members by some means for preventing decay, but in China, so far as I have been able to learn, there exists only two timber treating plants, and both of these have remained idle for many years.

Experience of the past has shown that experience and methods of other sections should not be adopted blindly but this should not be a reason for refusal to draw lessons from the benefits which have been derived in other countries from the preservation of their timber. The conditions under which these benefits have been derived should be analyzed and if it is found that the methods can be adapted to conditions in this country, with similar results, this is the course which should be followed.

Let us first examine the points of similarity and dissimilarity in the supply and use of timber in China and the U.S.A., where the character of use and exposure to decay are somewhat similar, as from the latter country, we may secure a large amount of information concerning the use of preservatives. As the bulk of this available material has been compiled by the various railways, this discussion will be concerned principally with railway bridge timbers and sleepers.

In my own early experience in railway work, most of the railways of the Mississippi valley and of the states to the east of that valley, ran through a country in which timber for sleepers could be secured from near-by sources, the initial construction often depending on timber cut from the right of way. Only twelve years ago, I was engaged in construction of a railway extension in the state of Mississippi on which the sleepers came from a distance not to exceed fifty feet from the center line of the railway.

In many parts of the Southern States, and in the Pacific North-West, there are millions of acres of virgin forest from which timber is being cut for the domestic supply and for export, yet with this comparatively cheap supply still available, and a few of the re-planted areas already producing timber of merchantable size, the most of the more progressive railways have adopted the policy of giving their sleepers and structural timbers a preservative treatment before placing them in the track or structure. This is not done from any altruistic motive of saving timber for future generations, but as an economy measure, affecting the cost of maintaining the property during the next very few years.

The causes which have led to the use of treated timber in the U.S.A. have been various though it has been due principally to the intensive study of the economics of maintenance, made by the leading railways of the country. Fifty years ago, the idea was barely discussed. Sleepers cost little more than the cost of making and transporting them and labor was comparatively cheap. At the time that timber treatment was started, excellent white oak ties could be purchased for about G.$0.40. As these had an average life of nearly twelve years, it was not customary to treat them, even after the treatment of lower-grade timbers had become general. At present however even the best of woods are treated if used as railway sleepers.

One of the most important advantages which has been gained by the railways through the treatment of sleepers has been the great increase in varieties of wood which may be used. A few years ago, such woods as cottonwood, various gums, poplar, etc., were to be found in many sections of the country but, as they were considered worthless for anything but fuel, and not very good for that there was practically no market for them. By giving such woods a preservative treatment, they make excellent railway sleepers. Gum sleepers now constitute about twelve per cent of all the woods used for sleepers in the U.S.A.

Turning our attention now to conditions in China, especially as regards sleeper renewals, we find that there are three principal sources—Native pine (with a limited amount of other native woods); Pacific Coast "pine" (Oregon fir from the U.S.A. and Canada); and hardwoods imported mainly from Australia and the Philippines. There are a few steel sleepers in use in this country but these will not be considered for the present.

It is doubtful if one may safely estimate the average life of a sleeper of native pine at more than four years, or the Oregon fir at more than six. The imported hard woods will have a much longer life but their cost makes their use almost prohibitive.

The most (though not all) of the factors tending toward economy to be secured through the use of timber preserving methods, as applying to the U.S.A., will be even more forceful in China. The most readily available local wood, the Chinese pine, is extremely shortlived when exposed to the weather—I have seen destructive fungi in profusion on sleepers which had not been cut to exceed ten months and had not been in the track for more than half that length of time. Some of these will barely give one year of useful service. Oregon fir will last somewhat longer but it is doubtful if the average life will exceed the above estimate of six years, yet either of these timbers should have a useful life of not less than twenty years if given a suitable preservative treatment. There is some doubt as to the economy of using the native, untreated, pine, if better material is procurable, but this same native pine sleeper would be most suitable if treated to prevent decay.

Lower labor cost would tend to reduce the cost of treatment in China, as compared to the U.S.A. but this might be more than offset by the higher cost of preservative materials. If creosote were used in sufficiently large quantities to permit tank-ship delivery however, supplies might be procured from European sources at a price comparable with those which obtain in the U.S.A., where many of the plants are located inland, involving a long rail haul on materials.

Various agencies in the U.S.A. and other countries have done much in the way of experimental research, tabulation of service records, and analysis of records to determine the best methods of treatment, the best materials, and the results which may be

* *Chinese Economic Journal*

expected from each. Notable among these agencies are the U.S. National Forest Service, the American Wood Preservers Association and the American Railway Engineering Association. Many of the investigations have been carried on jointly by these three organizations and, for this reason, the results are especially comprehensive and authoritative.

Through the action of the Government and private interests, standard specifications have been adopted for the materials to be used as preservatives and the methods for their application, though provision is made in these specifications for various preservatives and various methods for their application. While pressure treatment has become accepted as practically standard, especially for wood requiring the maximum of protection, several plants are still using the open tank method, by which there can be no pressure application. Use of the open tank is especially common in treating telegraph and telephone poles as, by this method, it is possible to treat the butts only. Poles decay most rapidly in a zone confined between a space about one foot above ground and one foot below. By protecting this portion of the pole by immersion in creosote or other preservative, several years of life are added, though the results are not equal to those secured by the pressure treatment. The brush method has quite generally been discredited as being of doubtful economic value.

The member-railways of the A.R.E.A. are always ready to test out any new method or material bearing promise. By such experiments, they have added materially to the knowledge of timber preservation, and have also assisted in protecting the public from worthless and fraudulent methods and materials. The most of the "secret formulae" which appear from time to time have been found to fall within one or the other of these two classes.

A large proportion of the railways of the U.S.A. depend on creosote oil for the preservation of their timbers though there is a considerable use of zinc chloride, of zinc chloride with creosote, dilutions of creosote with petroleum, and various other combinations. In the case of railway sleepers, less than one-tenth of one per cent were treated with materials containing neither creosote nor zinc chloride. The following table will give an idea of the relative proportion of each type of preservative used.

Either creosote or zinc chloride appears to afford satisfactory protection against decay, so long as it remains in the pores of the wood, but the zinc chloride leaches out more readily and under certain climatic conditions, its use is not recommended. In its specifications for the preservative treatment of wood, the U.S. Government states that zinc chloride "is not recommended for arid or for very wet regions," also that "zinc chloride is cheaper than creosote but does not protect the wood so well, especially under wet conditions or in a warm climate."

Record of Sleepers Treated in the U.S.A. in the Year 1928

Condensed from "Treated Timber—Its Uses and Economies," a pamphlet issued by the U.S. Department of Commerce.

NUMBER OF SLEEPERS TREATED

Variety of wood	*Creosote* (3)	*Zinc* (4) *Chloride*	*All others*	*Totals*	*Per cetn*
Oak[1]	24,697,306	2,954,153	11,501	27,662,960	39.5
Pine[2] ..	14,417,685	3,054,095	3,500	17,475,280	24.9
Douglas Fir ..	6,260,330	1,280,930	40,000	7,581,260	10.8
All others ..	11,323,176	6,071,729	——	17,394,905	24.8
Totals ..	56,698,497	13,360,907	55,001	70,114,405	
Per cent ..	80.8	19.1	0.1	100	

(1) Includes all varieties of oak.
(2) Includes all varieties of pine.
(3) Includes straight creosote as well as mixtures with petroleum, coal tar, etc. About 70 per cent of whole was "straight."
(4) Includes straight zinc chloride, dissolved in water, and various other mixtures using zinc chloride. The straight zinc chloride solution was used for about 79 per cent of the whole.

Excepting where the climatic conditions are decidely unfavorable for the use of zinc chloride, there is no valid reason why existing economic conditions should not dictate whether this, or creosote should be used, though in evaluating these economic conditions, weight should be given to the relative period of effectiveness of each, as well as first cost. As the same plant equipment is suitable for use of either preservative, a change from one to the other may be made as changing conditions may dictate.

Status of Timber Preservation in China

So far as I have been able to ascertain, there have been built in this country only two plants for the preservative treatment of timbers, both designed for treating timbers of reasonable length but both having been practically confined to the treatment of railway sleepers. These are the plants owned by the Peiping-Hankow Railway and the Tientsin-Pukow Railway, located at Hankow and Tsinan respectively. When the preparation of this memoir was undertaken, both plants had been idle for a number of years but a recent letter from Mr. Jick G. Wong, Chief Engineer of the Pei-Han line advises that the plant at Hankow has again been placed in operation, using the zinc chloride solution for treatment of sleepers.

To what extent an increase in capacity of these two plants may be warranted at this time, it is difficult to state, though even with the present limited amount of new construction under way, it is certain both should be operated to fullest capacity and that some additions, or new plants, should be built. The short life of unprotected timbers in this country, and the high cost of renewals, will insure a high return on the investment for the use of a preservative treatment of all sleepers and other timbers used in exposed locations. One might hesitate to urge additional plant investment if the benefits to be derived can be reaped only by future generations, but the actual money returns, within the present generation, are sufficient to justify the expenditure necessary to protect such timbers from decay.

Not only should such treatment be adopted as standard practice to prevent decay, but a heavy creosote injection should be used as a protection against marine borers in wharves and piers and to protect land structures from destruction by termites.

In the U.S.A., where climatic conditions are similar to many portions of China, the U.S. Department of Commerce estimates that "the loss (of timber) through decay is still appalling, amounting annually to one-fifth the timber cut." There appears no reason to believe that conditions, as regards loss through decay, are much different here than in the U.S.A. and, if this is the case, it should require no further argument to convince one that timber preservation should be adopted as standard practice in China, without further delay.

Treatment of Railway Sleepers in the U.S.

In about 1880, a few engineers became interested in the studies of timber preservation which were being made in Europe, especially in Germany, but during the next twenty years, railway sleepers were treated only in an experimental way and other timbers were treated only to a very limited extent. At the annual meeting of the American Railway Engineering and Maintenance of Way Association (now the A.R.E.A.) of 1901, a paper on the subject of the preservative treatment of timbers was read by a young German engineer, Dr. Herman von Shrenk which added greatly to the impetus of timber preservation, especially of railway sleepers. Dr. von Shrenk has remained in America since that time, devoting his time to furthering the idea of decay prevention. Only a few months ago, he assisted the writer in securing material for this memoir.

In 1902, a few of the larger railways started the use of treated sleepers on a considerable scale and each year has witnessed the use of an increasing proportion of these. Through the "Timber Preservation Committee" of the A.R.E.A., records are collected each year, from the member railways and these are published for the information of members and the public generally. As these records now cover a period of over thirty years, and exceed the average length of life of treated sleepers, they form a most valuable source of information. This value will be increased with the passing of each year.

Basing its figures on the reports made by the various railways, and on its own independent investigations, the U.S. Forestry Service estimates the average life of treated sleepers at twenty years, while the records of the New York Central R.R. show that the average life on that road exceeds twenty-two years. This railway was among the first to use creosoted sleepers on a large scale, some of those which were placed in 1902 being still in service. In the pamphlet already quoted ("Treated Timber—Its Uses and Economies") it is estimated that "the railways of the United States are effecting a net saving of $53,000,000 per year by the use of treated ties."

In spite of the fact that axle loading, total tonnage and train speeds increased substantially during the period from 1900 to 1929, the average renewals of sleepers, on the twenty-seven roads reporting dropped from 264 per mile in 1900 to 170 per mile in 1929. This figure becomes even more impressive when we consider that the average quality of timber used during the later years was far below that of the earlier years. Also, it should be taken into consideration that the figures of renewals include removals for all causes—mechanical wear, breakage by wrecks, etc., as well as decay. With the lower axle loads and lesser speeds prevailing in China, destruction of sleepers by mechanical wear should be reducible to a minimum.

Wooden Bridges and Trestles

There are no records available, covering structures of this type, which are at all comparable in extent with those of sleepers, though there are innumerable examples of individual structures which are convincing proof of the money returns which may be secured by the use of a protective treatment. Not only is it possible to secure practical immunity from loss through decay, but some protection against loss by fire is also secured. As this latter point has received all too little attention in the past, it will be discussed first.

While the treatment of timber by any of the standard processes will not result in a fire proof material, it is a generally known fact that the zinc chloride impregnation adds materially to the fire resisting qualities of timber. In the use of creosote, the question is somewhat different, in fact, many disastrous fires in timber treating plants and storage yards have been due to the accidental ignition of gases given off from freshly creosoted stacks of timbers, piles and sleepers. In this way, creosoting has been given a rather unenviable reputation as adding to the fire hazard. With a better understanding of the material however, and an appreciation of the danger from accumulating gases, such fires should not occur. Treated timbers which have been exposed to the weather for some time, especially those employed in railway trestle construction, have a definite fire-resisting quality. They do not ignite readily and even after ignition, the non-inflammable materials in the outer pores of the wood will frequently cause the fire to go out even after gaining considerable headway. There are cases on record of long timber trestles, constructed entirely of creosoted material, which have been on fire for their whole length, but on which the fire has gone out for no reason other than the resistance offered by the remaining solids with which the wood had been impregnated. In at least one such instance, trains were passed over the structure, after the fire, and with no repairs having been made after the fire.

A highly inflammable gas is given off from freshly creosoted timbers, especially in warm weather, but the danger from this source is practically eliminated in ordinary timber trestles as there is no opportunity for such gases to collect at any point in dangerous quantities. Sparks from a locomotive seldom set fire to a creosoted structure, the principal source of such fires being burning grass at the base.

One of the best early illustrations of the use of creosoted piling and timbers in railway trestle construction is afforded by the trestle, six miles in length, which was built in 1883, by the New Orleans and Northeastern Railway (now a part of the Southern Railway) crossing one end of Lake Pontchartrain. Excepting for two steel draw spans, this structure is entirely of creosoted timber. It is described in the Transactions of the American Society of Civil Engineers (Volume 56—Page 10) by Mr. James Haugh, who was the resident engineer in charge of construction and who remained as maintenance engineer for many years after. In his article, which was written 23 years after the trestle was completed, he states that during that period, no brace planks (sway braces) had decayed, no stringers had decayed, but that it had been necessary to renew several of the caps. It was Mr. Haugh's opinion that the decay of the caps was due to the weathering of the exposed ends which had split open at the ends beyond the zone reached and protected by the creosote.

From later conversations with Mr. Haugh, followed by an examination of the structure in 1914 (when it had served for more than forty years), I found that practically all the original piles, braces and stringers were still in service and apparently fit for many years more. In about 1910, and again several years later, Col. W. B. Gregory, Professor of Experimental Engineering of Tulane University at New Orleans, made a number of tests of stringers which had been selected at random from this trestle. Results of these tests are published in Volumes 70 and 76 of Transactions of the A.S.C.E. Col. Gregory reports that none of the timbers showed signs of decay and that on loading to destruction, "the strength compared favorably with that of new, untreated timbers."

Many of the larger railways own and operate their own treating plants though there are independent, commercial plants in most of the timber producing sections of the country. In 1928, there were 193 plants in active operation within the United States, with several more over the border, in Canada. There are twenty plants in the Pacific states of Washington, Oregon and California. Until it is possible to secure additional facilities for use in China, it should be possible to secure treated timbers from these Pacific Coast mills in sufficient quantity, though it would almost certainly cost more than to import the untreated timber and add the preservative here.

No data are available showing the saving which can be made by local treatment, over the cost of imported, treated timbers but it is obvious that this would be considerable.

While the purchase of second-hand machinery, for shipment to a foreign country, is seldom economically warranted, it is not certain that this would hold true of timber treating plant equipment as the principal elements of such plants do not deteriorate rapidly. It is quite possible that a good bargain might be secured on materials suitable for use in China, at plants which either have been discontinued, or are changing over to handle extra large timbers. The main cause for abandonment of plants in the U.S.A. is the cutting out of the timber supply in the locality of the treating plant. When this occurs, it is possible to purchas pressure tanks and other essential parts at a very low figure. This point might well be investigated before purchases of new material are made.

While there may be some doubt as to the type of preservative to be employed, capacity of plants to be provided, where they should be located, and a number of other points, there can be no doubt that the treatment of all timbers used in exposed locations in this country will yield a handsome and an early profit, benefiting both the present and future generations. With a well-planned and vigorously executed program of re-forestation; the adoption of a wise policy for the protection of forests; and the preservative treatment of timbers, China should become an exporter of lumber and forest products, instead of an importer.

Electric Equipment in Japan

The principal items of electrification equipment provided by the Tokyo Electric Office of the I.G.M. under this year's program are: The Yugawara-Mishima transmission line (Y.325,000), the Atami-Numadzu line (Y.600,000), the Mishima substation (Y.580,000), the Yugawara substation (Y.290,000), the Ichikawa-Funabashi line (Y.193,000), the Funabashi-China line (Y.120,000), the Koiwa substation (Y.100,000), the Nakayama and Inage substations (Y.100,000 each), the Uyeno-Kitasenju line (Y.120,000), Shinagawa station, Tsurumi line (Y.185,000), the Kofu-Nirazaki line (Y.110,000), and the Haramachida-Hachioji line (Y.100,000).

Construction was to commence last month on the 64,000 kw. Tsurigame power station of the Japan Power Co., and the Akita Prefectural Office is planning the erection of a 20,000 kw. power station, utilizing the waters of Lake Tozawa. The latter station will cost about Y.7,000,000 and will be completed by 1939.

The Yahagi Hydro-Electric Co. proposes to purchase four 15,000 kw. generators and other electrical equipment for its Taifu power station.

Primitive Mining in the Philippines*

Gold and Copper Mining Methods of the Igorot on the Island of Luzon and an Account of some of the Religious Beliefs by which their Work is Influenced

By LAURENCE L. WILSON

DURING the past year the author has been enjoying the experience of prospecting for gold in the Central Cordillera Mountains, the backbone of Luzon, Philippine Islands, the home of the Igorot, who from time immemorial have been mining in these rugged, pine-clad mountains. For months at a time these virile, enduring, mountain-minded people have been his only companions. He has visited most of their workings, some not previously seen by a white man, and, with increasing respect, has become acquainted with their mode of mining, which he thought worthy of record.

Tradition indicates that the knowledge of gold may have been brought with them by the Igorot when as the advance guard of the Malay race, they came out of the west, invaded the Philippines, and finally settled in these mountains—possibly about the time that Solomon was getting gold from Ophir. Traces of his early Hindu culture are seen in such practices as animal sacrifice, augury, and trial by ordeal. The Igorot still treasure an old volume written in the ancient script, which they have long since forgotten how to read. This knowledge of gold was no doubt stimulated and increased by the Chinese, who, as pirates and merchants, were visiting the Philippines as far back as the seventh century. The Chinese did a considerable amount of mining here at times—both lode and placer—and traces of their influence are sometimes seen in methods of timbering the shafts, use of tools, and other practices. The Spanish influence was apparently little felt, as the fierce highlanders ably defended their mountain fastnesses and were unconquered by the Spanish until 1846. Even then the conquerors got most of their gold from the Igorot and taught them little. The Igorot, who love a practical joke, sometimes led the Spanish speculators to drive quite extensive tunnels where there was no chance of getting rich. Thus, while learning from others, these industrious people have through the centuries developed their own methods, due to their peculiar manner of life and the type of ore in which they find the precious metal. The Americans have brought modern mining methods into these mountains and employed many Igorot in their rich mines, where they have become efficient with jack-hammers and dynamite. The author, however, will try to describe the Igorot processes as uninfluenced by modern invention and as still practised in some localities.

The Author and one of his Staff

The Kankanai and Kabaloi tribes of Igorot have developed into the best miners, most of the gold being found in their territory. While the metal is found more or less all through the tangled and tumbled mountains, the main Igorot mining districts are those around the barrios of Suyoc, Tabio, Akupan, and Antamok. Suyoc is usually considered to have been the first large mining center and Suyoc miners are still said to be the most expert.

In this brief general description of Igorot mining methods, of course, it must be remembered that different customs and modes may exist side by side, that there are all grades of ability, and that not all the Igorot are miners. Many a time the author has been guided by an enthusiastic Igorot over steep mountain trails, through runo and bamboo thickets, and up rough rocky gorges, only to arrive at a barren lode.

The mountain men are indefatigable prospectors. Also their other life interests—hunting, fishing, going to distant camote patches and rice paddies, gathering wood, attending live stock, and other activities—all lead them to visit every neck of the woods where outcrops, slides, and cuts are investigated for gold-bearing veins. Thus, while modern American methods have developed old veins and opened adjacent new ones into among the richest mines in the world, gold has not yet been discovered in localities unknown to the Igorot.

He is a gallant gambler, not only in looking for surface indications, but will often tunnel a likely looking prospect until past the hope of developing a paying proposition. Moreover, by his industry and simple living, he is enabled to work many stringers on which a white man would soon starve.

Custom of Working

Gold mining is more or less a community affair. The allied family in one small barrio may own a combination of the lode and placer mine in a portion of a mountain together with the gold-bearing gravel of the stream following therefrom. They usually work it individually, each person taking for his own that which he produces. Occasionally, when they feel that they can trust each other, they mine in common, each receiving an equal share of the gold produced, but the head man receives a larger share for supervision. Often, of course, one man will own the mine and employ help on a share basis or for a daily wage. Much of the mining is seasonal, so that farming and other minor industries go on alternately and often coincidently with the mining industry.

Utensils

The primitive tools of these patient miners are: A short, pointed gad made of fire-tempered wood or steel sometimes lengthened with a wooden handle, a stone or hardwood hammer, wooden wedges, and a short wooden shovel, together with various sized baskets woven of split bamboo.

While most of the iron is imported, the people early learned to work the metal and are good smiths. The bar is heated in a charcoal fire, shaped with a stone hammer, and tempered by plunging into water. The bellows, used to produce an air draught on the charcoal, may be a clever arrangement of wooden pistons working alternately in two or four bamboo cylinders. Sometimes hollowed logs or boxes, constructed of slabs of wood, have been used in place of the bamboo. One box type has a single double-acting piston. An opening is provided in each end for the admission of air during the back stroke and a flap of hide is placed over this to act as a check valve during the down stroke. The

**The Mining Magazine.*

simplest bellows consists of two fans, woven of split bamboo, which are waved alternately back and forth quite efficiently.

For lighting the tunnels a torch may be formed of a bundle of long, thin splinters of pitchy pine wood. It has been the custom to start a fire either by striking flint with steel or through friction heat produced by rapidly twisting one bamboo stick in the hollow of another.

Using their simple tools the Igorot have made many excavations along the line of the gold-bearing veins. They would break down the rock by building a fire against its face and dashing cold water on the heated surface. They carry out the ore in baskets—the gangue likewise—or drag it out in larger baskets or stoneboats made of hollowed logs drawn by carabao hide thongs. Many tunnels are necessarily small and tortuous—following the ore in the hard rock—but some creditable shafts, rises, winzes, stopes, and fills are seen. The best Igorot methods of timbering, stoping, and back filling are admired even by American miners.

The Igorot worked in and down as far as feasible, driving tunnels many meters long and putting in rises or shafts until stopped by very hard rock or waterflow. All the great mines in this district are developments of old abandoned Igorot workings.

Cross Staking Claim to a Tunnel

The Igorot are expert in the recovery of gold from the ore. This is the work of the women. At a glance they pick out the pieces containing gold, which are broken, if necessary, to about the size of a pea and then crushed by being placed on a large hard flat rock and rolled with a heavy stone—say, 50 cm. in diameter.

This ore is carried to a spring or stream, where it is ground to a slime by rubbing. A hard, flat stone, placed perhaps on a wooden frame for convenience, is used for the nether stone, the ore being placed thereon, soaked with water, and rubbed back and forth with a fitted hand-stone. There may be as many as a dozen of these stones in one group or mill, the women working sociably together and the small children playing about.

In free-milling ores the clever women recover a very high percentage of the gold, but in complex ores, such as the tellurides and pyrites, they are not so successful. Sometimes they roast the ore before grinding or they may afterwards set it away in a tunnel where natural disintegration takes place. They then pan it out each year for a number of years, saying that the gold is growing in the ore. But they have back-filled tunnels with waste which assayed as high as $100 per ton and certain of their discarded concentrates have assayed $2,500 per ton.

The slime is panned out in a shallow bark or thin wooden shell, bound with bamboo. It is about 70 cm. long and 30 cm. wide turned up some 6 cm. on the sides, being open at the ends—one slightly more flaring. Water is slowly admitted at the opposite end and, accompanied by a certain gentle shaking movement all its own, together with handling, the waste is separated and

Igorot at Work in Tunnel

washed off, leaving the glittering gold in the tail. This is removed to a half coco-nut shell and later stored in a small section of bamboo. Sometimes the juice of the leaf of the aglayan plant or of dampened tobacco is squeezed in the water while panning. This is to cause the fine floating gold to go to the bottom—the reverse of the modern flotation process.

When enough gold has been accumulated it is melted in an iron dish, with a charcoal fire, into bullion. It is often purified by means of several heatings, using salt or sometimes soda as a flux and skimming off the slag each time. Some of the Igorot are very adept at adulterating the gold and improving its color by the addition of copper and silver and a final roasting in salt.

Placer Mining

Much of the Igorot mining is placer. All the streams flowing from the auriferous regions are regularly worked after each rainy season. The best sections are usually owned and worked by certain individuals, some of whom have built quite intricate, permanent, rock-walled sluice-boxes which catch the descending gold throughout the rainy season.

At the beginning of the dry season the owner cleans out and repairs or rebuilds his sluice-box, which may be 25 m. long. The rough surface of the bedrock of the river channel serves as the bottom of the sluice-box, while the sides are more or less symmetrically placed convenient boulders. A part of the stream is directed into this " box " and the gravel deposited during the high water sluiced through, the heavy gold sinking to the bottom and being caught by the natural riffles formed by crevices in the rock bottom. These riffles are then carefully cleaned out and the contents panned by the women in the same manner as related previously.

The most characteristic manner of Igorot mining is to start working the gold-bearing vein where it outcrops—maybe near the top of the mountain. During the dry season the men dig potholes and dog-holes one above the other. A long ditch is dug along the mountain to catch water during the rainy season or perchance to conduct it from a convenient stream or spring. This ditch may lead directly to the workings or to a storage reservoir, according to conditions. When a sufficient head of water is acquired it is directed into the workings and they are boomed out, exposing the vein for the next season's work.

In this way big cuts and slides are made. At Suyoc the huge Pelidan slide is ½ km. wide and the rich vein, from which half a million pesos' worth of gold is reported to have been taken, is covered several hundred feet underneath. In some places, where the whole mountain is permeated with free gold and small stringers, the entire mass is being washed down—a part each year, as the water is directed into different gullies. In many cases the stream below is worked during the dry season and the gold-bearing gravel panned by the women.

While much of the gold is disposed of in the form of bullion, the Igorot love the metal for itself and have made ornaments and utensils for their own use. They mould and hammer out ear-rings, necklaces, finger-rings, carabao, and pig figures and at Tabio they mined the gold which they beat out into gold dishes and even a hat. Fernando Fienza, a former rich owner of an Antamok mine, had manufactured from gold a whole set of dishes and numerous other articles.

Copper Mining

While gold is by far the chief mining interest of the Igorot, they have mined salt, flint, opal, magnetite, and possibly coal and iron, but their other main mining interest has been copper. The copper ore body in Mankayan, which carries about 20 per cent copper, was successfully worked for centuries before the advent of the Spaniard. In mining this ore the Igorot divided the district between the small barrios. It was again subdivided, a section to each family, each working its own claim. The ore was broken down by means of iron instruments and by fire, which was also used to break up the rock due to the action of the steam produced from the water content of the rock. The native copper was picked out of the ore and the balance roasted in a furnace.

The furnace was constructed with a round hollow base in clayey ground, some 30 cm. in diameter and 15 cm. deep, surrounded by a loose stone wall about 50 cm. high. An inclined conical funnel of stone admitted the forced draught from a compound bamboo bellows. About 20 kg. of the sulphuretted ore was placed in the center of the furnace, with charcoal along the sides. It was roasted about an hour and much of the arsenic and antimony, with some sulphur, was eliminated. The roasted ore was then placed in a fire-clay crucible in the form of a still and smelted for about 15 hours to a matte.

The matte was super-roasted in the furnace for an hour in contact with charcoa' and limestone in order to slag off the iron. Some black copper would melt out and collect in the rounded bottom of the furnace. Cold water from handy vessels was poured upon the remaining semi-molten matte, resulting in thin plates of copper being formed. This " Rosette " copper was stripped off and stored. The cuprous oxide in the remaining matte was reduced by again roasting it in the furnace between rows of wood.

The product, together with the black copper, was again placed in the crucible, smelted, and poured out into clay moulds. To prevent the surface of the cooling metal from oxidation the Igorot beat it with green twigs.

These commercial copper ingots, which had thus been extracted with so much skill and patience by the Igorot, were over 90 per cent pure and represented about a 50 per cent recovery from the ore.

If the copper was to be employed in the manufacture of kettles, pipes, and other domestic articles it was further refined in the furnace and the carbonaceous compounds were oxidized out by reducing the quantity of charcoal and increasing the air-draught.

Native Crushing Stones

Something has been told about the physical and social aspects of Igorot mining, but the religious aspect should not be neglected, for the Igorot are very superstitious people and their daily life is much influenced by their religious ideas. The Igorot believe in one supreme being—Kabunian—and in many supernatural beings of various ranks and characteristics. These, known as Anitos, have the intelligence and sensibilities of human beings, but have superior abilities and lack a corporal body. They may be good or bad, friend or foe, and one must keep on friendly terms with them by means of obedience and sacrifice if he is to succeed in his undertakings. Favored men or women, who might be called wise men, have the ability of communicating with these Anitos and expect to become Anitos themselves upon their death. Some of their lore should prove of interest.

Gold has been grown by and belongs to the Anitos. When it is found in a tunnel the miner must make an offering payment either of blood, by cutting the finger or toe of one of the men, or else a cañao is made. A cañao is a ceremonial feast and sacrifice—typified by slaughter of animals, feasting, dancing, and usually drinking tapoi (rice wine). Only pigs are killed at cañaos made in relation to mining gold. After they kill the pig the wise men pray, saying: "We would not take this gold if we were not hungry. Please forgive us and accept this pig as payment for the gold." Then the pig is butchered, cooked, and eaten.

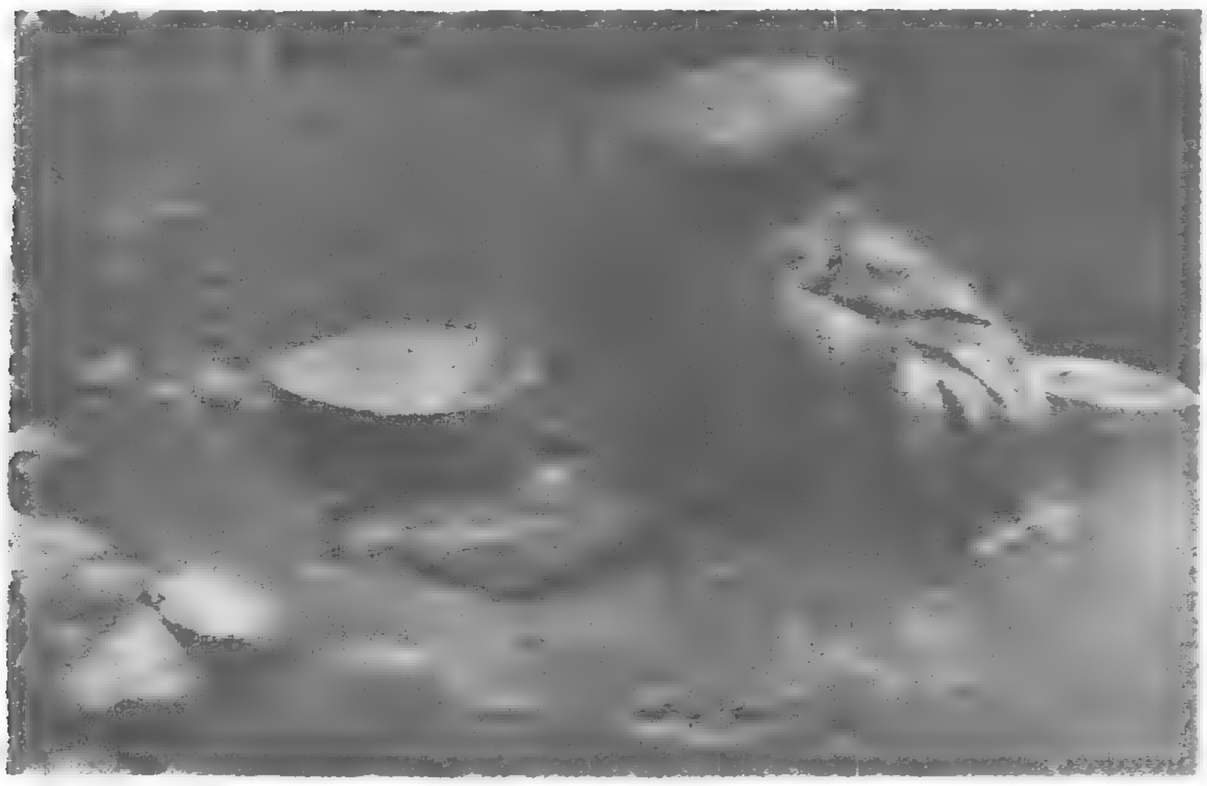
When the ore is taken out the gold must be extracted as soon as possible or some will go away. A cañao should also be made before melting and refining the gold, so that none of it will leave.

There are certain things which a successful Igorot miner does not do. When working in a tunnel one can eat the flesh of the pig and carabao, but not of the cow, for the cow does not lie in the mud. One must not whistle or sing in his tunnel and a woman must not step over the tools.

Sometimes the Anitos communicate with men in omens and augury. If one is going on a journey and a certain animal or small bird crosses the trail one must return home and propitiate the Anitos before starting again. If the bird flies in the direction the man is going, he sees a good omen in that event and expects a successful prospecting trip, or if going to sell his gold he will expect a good price for it. If he wishes to discover the condition of a vein, the Igorot may kill a chicken and observe the bile sac. If full of a liquid of dark color it is favorable, but if pale and empty there is not much hope.

Sometimes a miner may be so fortunate that an Anito displays to him a bright fire some night. If he goes there the next day he may expect to find gold. If the fire was high the gold is deep, but if the fire is low the gold is not far down in the ground. Numerous instances are given of this method of finding gold. The Dugong (meaning, very rich mine) at Suyoc was thus found and Chugchugan followed the sign of the

Fine Grinding on a Rub-Rock



Recovering the Gold

Cleaning up a Creek Bed

fire at Acop and found the Pitkil from which much gold has been taken. Sometimes the Anitos reverse the action. At Anginteg in Ampusungan there was a prosperous mining community with a number of rice paddies. One night an Anito appeared to one of the wise men and said: "We do not wish to live here any more." So the people moved away and you just see a number of rubbing stones scattered about in the grass.

If the people desire better fortune in finding gold in a tunnel they may cañao a pig there, but no tapoi is drunk. A level place is made near the tunnel and there at eventide the pig is slaughtered. The blood is sprinkled in the tunnel and the meat boiled in a pot in which is placed a pinch of gold. When cooked, the wise men place some of the meat in the tunnel and pray: "Please accept this pig and bring gold from—(some known rich mine) and place it in our tunnel." Then they eat the pig. After which the wise man places runo sticks as a fence around the tunnel. No one is allowed to enter the tunnel during the next day while the gold is coming to it. On the following morning the wise man removes the runo sticks, the men enter and start digging out the gold.

Mismisan was prospecting for gold in Tabio. He found a small vein and was digging a tunnel, but found little gold. One night as he lay asleep there appeared to him an Anito in the form of an old man with white hair and flowing beard. The Anito said: "Dig in higher up above your tunnel." Then Mismisan woke up, but no one was there, so he knew it had been an Anito. In the morning Mismisan killed a chicken and looked at the bile sac. It was favorable, for there was sour, dark fluid in it. Accordingly he went to his prospect, dug in higher up, and found considerable gold.

An Anito appeared one night to Magastino, a Suyoc miner, and said: "Do as I tell you and go to your mine where you will find gold, but if you do not first follow my instructions, it will profit you nothing. First, get a spotted pig and kill it. Before killing it pray to us in order that we may know that you honor us in your tunnel."

Notwithstanding these instructions in the morning Magastino did not obey the Anito, but went directly to his tunnel, where he did strike gold taking out three and a half peso weight. However, on returning home that evening he became sick and in a few days died. Before dying he related his vision to his neighbors, who said: "Why did you not tell us before and we would have done as the Anito said, but now it is too late."

Native Flume for Hydraulic Operations

The gold in Suyoc, as in other districts, first stood in the shape of a great high tree which reached to the heavens. When it fell it was buried and some of the branches (veins) have been found and much gold taken from them. The main trunk has not been found and remains buried very deep.

Gold was first discovered many generations ago at Suyoc by a band of boys from near Cervantes, who were out on a fishing trip. They took a short cut over the hill and saw the gold in the shape of a pig rolling along the ground and had difficulty in catching it. Then they tried to carry it, but it was too heavy. So, leaving one boy on guard, they went to get some men to help. The boy on guard became impatient and started cutting up the gold pig. He cut off the ears and tail: then stood up to rest and look for the other boys. When he turned to the pig again it was no more. So the boys went home with only the gold ears and tail. Shortly afterwards the boy became crazy. Then the people knew that an Anito had been injured, so they made two enormous ear-rings out of the ears and tail and forced the boy to wear them. They cañaoed a great number of carabao, pigs, and chickens, thus trying to appease the Anito. However, the boy sickened and died, so they put the ear-rings in the coffin with him. This might have been the end, but a rapacious man stole the ear-rings out of the coffin. He became sick and thereupon broke down and confessed his crime. His people made cañao and tried to put the ear-rings back, but, as there were many coffins in that place, they could not find the right one. Since the people could not rid themselves of the ear-rings they have passed them down, a sort of plague, from generation to generation until now. Langbay at Sagada is the caretaker of the male ear-ring, whose name is Gumiland, and his brother-in-law at Taccon is the caretaker of the female ring, whose name is Barrong. Each year they must cañao three pigs of different sizes, for if they do not do this they become sick. The ear-rings are very much worn and have become small. They are of very fine gold and the male ring glows in the dark.

As a fitting conclusion to this description of the Igorot, their mining methods and customs, the following quotation from the account of Hernando Riquel, an early Spanish explorer, might be given. "There are many gold mines in these mountains. The ore is so rich that I will not write any more about it, as I might possibly come under suspicion of exaggerating, but I swear by Christ that there is more gold on this island than there is now in all Biscay."

Six Japanese Government Main Railway Lines Completed within the Past Decade

By W. HARVEY CLARKE, JR.

NEARLY 14,000 miles of railed roadbed throughout Japan proper—on the principal islands of Honshu, Kyushu, Hokkaido and Shikoku—have all been laid down in less than the 62 years which have gone by since the nation's first steam railway line was opened for operation in May, 1872. This initial section, running between Shimbashi station (Tokyo) and Yokohama, covered a total distance of only 15¾ miles (25.3 kilometers).

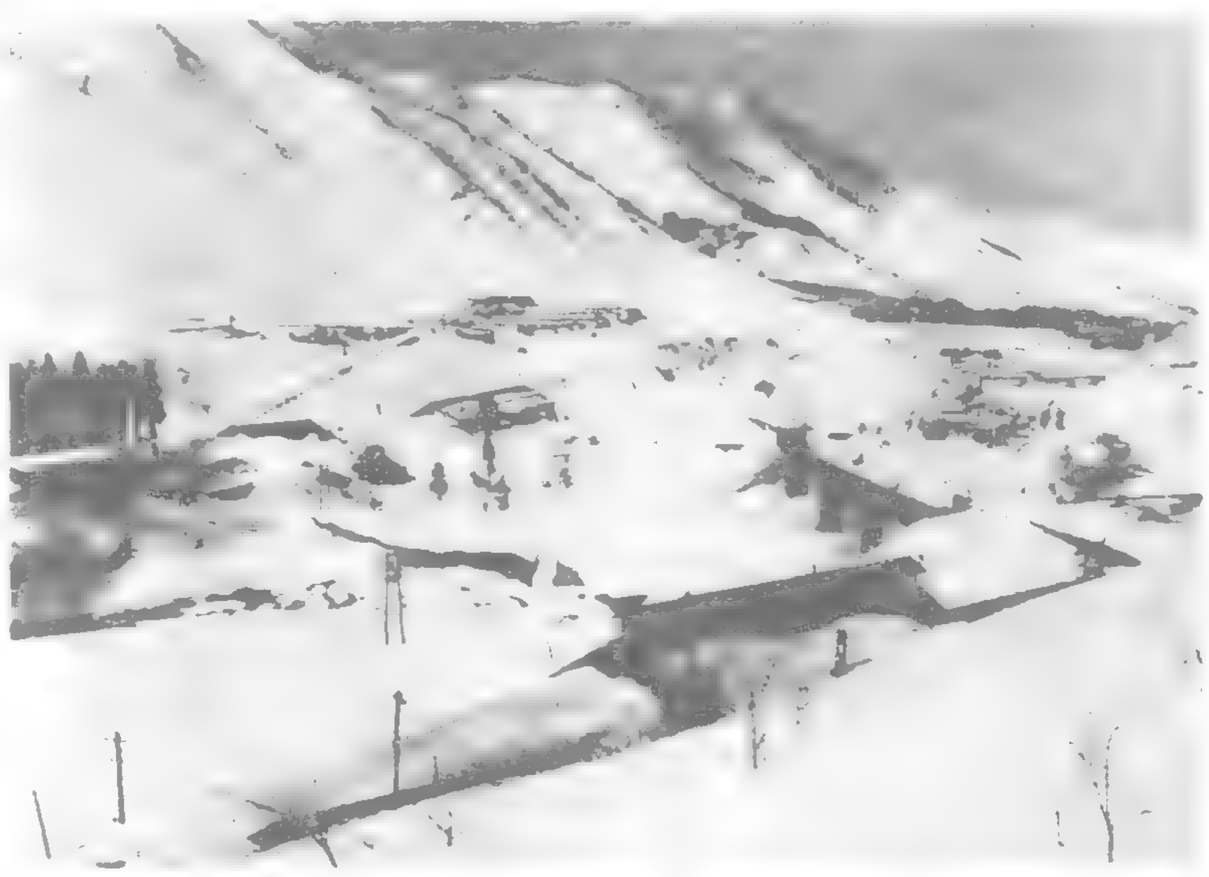
Eleven years ago—in 1922—in an endeavor to extend the service of the government railway system to districts so remote and difficult of access as not to have been sufficiently benefited by its operations, the Imperial Diet voted to carry out a comprehensive building program that called for the construction of 178 new lines within the near future. The total length of these lines, together with extensions of the then existing lines, was to reach about 6,349 miles.

Towards effectuating the terms of this resolution, 79 new lines with a total length of 1,997.2 miles have been completed and put into operation in the past ten years. To-day the construction of further new lines, estimated to total 1,863 miles in length, is well underway. By the close of the ten-year period ending in 1941, they are all scheduled to be in operation, according to Chief Ichiro Takemata of the Railway Ministry's Construction Bureau at Tokyo. This accomplishment then will complete considerably more than one-half of the 6,349 miles of right-of-way set as a goal back in 1922.

Yet the diffusion of railway facilities throughout Japan today, in direct proportion to the country's density of population and relatively limited area, is still factually inadequate to meet the needs for a rapid medium of transportation. Many rural communities have no speedier means of getting from one place to another than dirt or graveled roads. Except within the environs of or in the vicinities of cities and sizeable towns, concrete, or even asphaltum, paved highways are practically non-existent, unless, indeed, hard smooth-surfaced roadways have been built by the military to satisfy strategic purposes. In such cases, notwithstanding visible advances made in this direction since 1924-25, seldom are they favored with what may be termed genuine pavement.

As comparisons, the aggregate mileage of railroads in some of the world's leading countries for the year 1929 and their respective mileage rates per unit of area and of population is listed below :

Country	*Total R.R. Mileage*	*Mileage per 100 sq. miles of Territory*	*Mileage per 10,000 Persons*
Austria	4,371	13.5	6.7
Belgium	6,889	58.8	8.7
Denmark	3,306	19.9	9.5
England	16,526	20.2	5.0
France	33,261	15.6	7.4
Germany	36,362	20.0	5.8
Holland	2,312	17.5	3.0
Hungary	5,918	16.5	6.9
Italy	13,049	10.9	3.2
Japan	13,852	9.3	2.1
Mexico	16,433	2.2	11.5
Poland	12,845	8.6	4.7
Spain	9,853	5.1	4.4
Sweden	10,384	6.0	17.0
U.S.A.	249,383	7.0	21.0



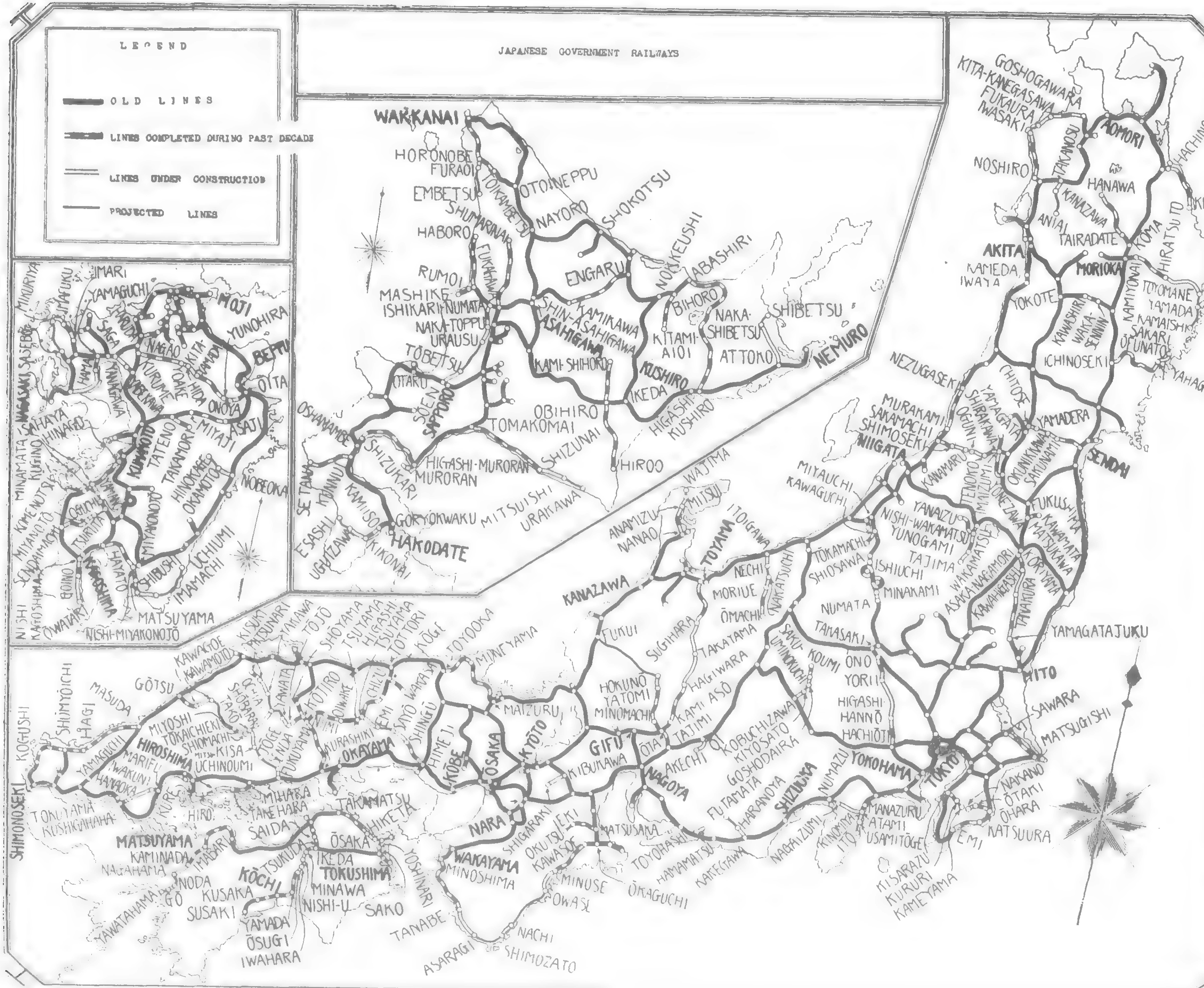
Mid-winter landscape of newly fallen snow near Shimidzu Tunnel (6.03 miles); in right foreground, First Uono River bridge crossing

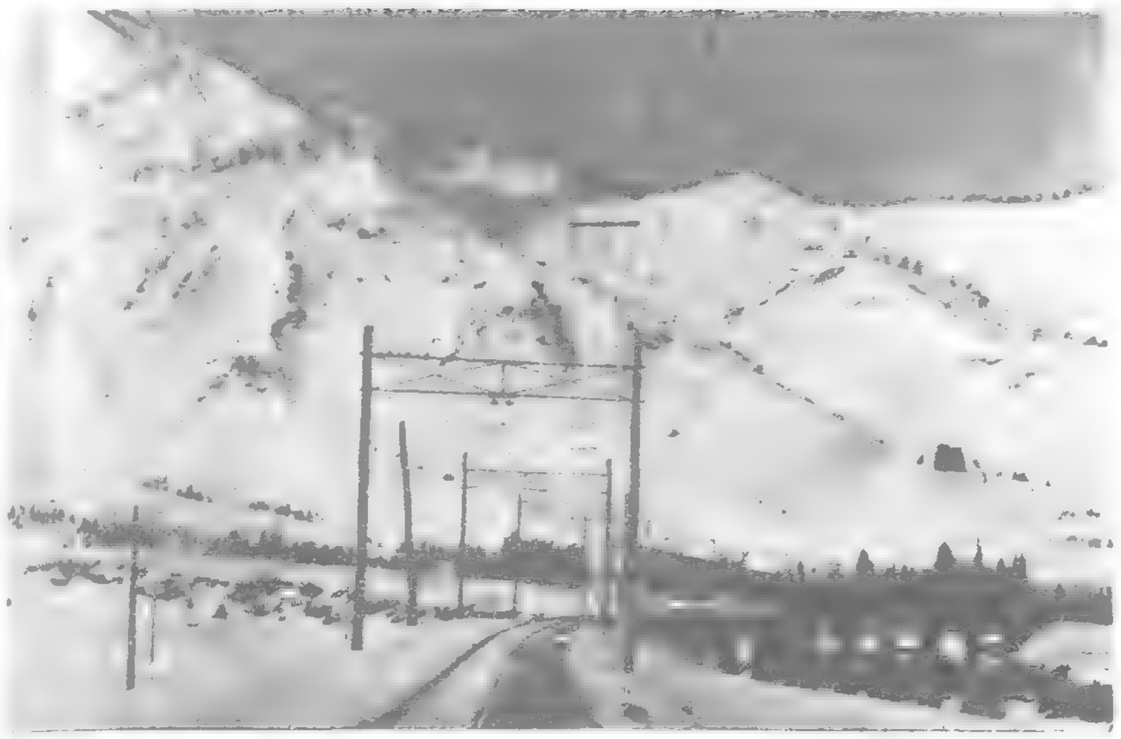
Following are brief sketches of the six new mainline routes completed in Japan proper in the past decade :

(1) *Uetsu Line.*—From Niitsu to Akita, Niigata and Akita Prefectures respectively, Honshu (Main Island); opened to traffic in July, 1924; length, 199.5 kilometers.

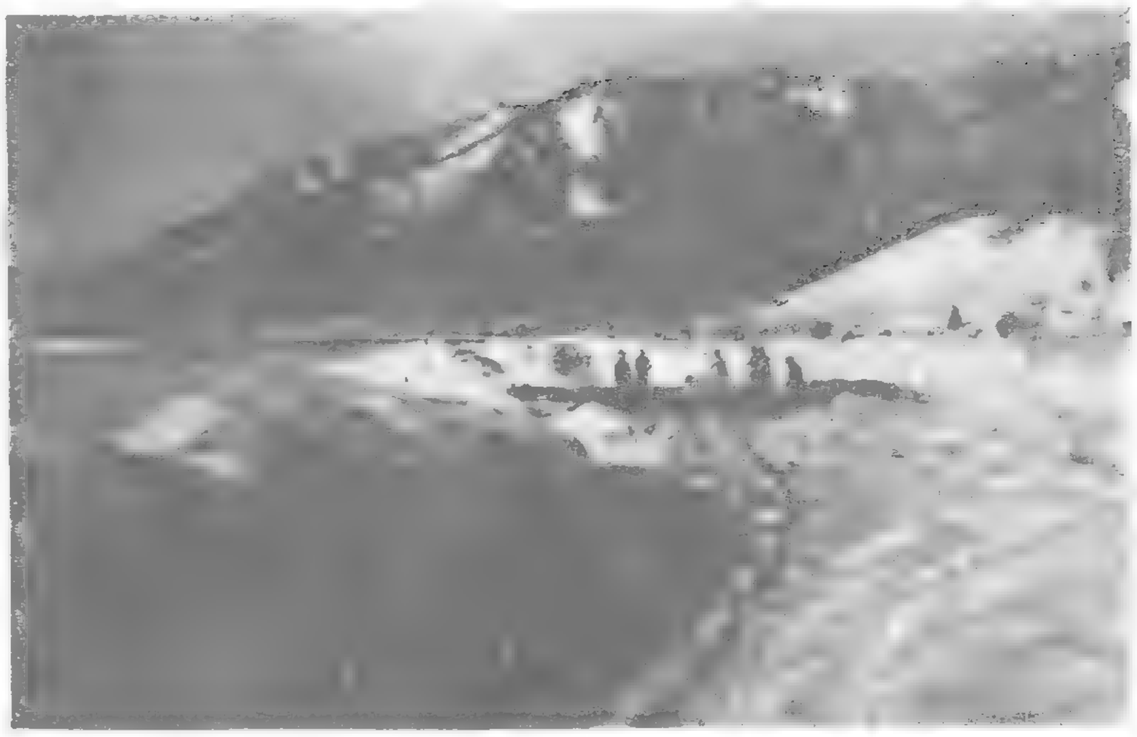
Constituting a coast route linking the towns of Murakami and Akita, this line extended the former Murakami line from its terminus at the town of the same name. Many tunnels driven through the foot of the range back of the point where Budo Pass slopes to the level of the Japan Sea intersect the course, which skirts a long stretch of seashore as it traverses a region known to be replete in

Chikugo River Bridge (1,671-ft.) under construction at Yabegawa, Saga Prefecture, Kyushu. Superstructure, plate girders 40, 50 and 70-ft. x 1-ft. and 120 x 9; Trusses, 150-ft. x 2-ft. and 85 x 1 lift span; Substructure, hollow, cylindrical, ferro-concrete piers with well foundations


JAPANESE GOVERNMENT RAILWAYS
LEGEND
OLD LINES
LINES COMPLETED DURING PAST DECADE
LINES UNDER CONSTRUCTION
PROJECTED LINES
WAKKANAI
HORONOBE
FURAOI
EMBETSU
OTOINEPPU
SHUMARINAI
NAYORO
SHOKOTSU
HABORO
RUMOI
ENGARU
ABASHIRI
MASHIKE
ISHIKARI-NUMATA
NAKA-TOPPU
URAUSU
SHIN-ASAHIGAWA
KAMIKAWA
ASAHIGAWA
BIHORO
NAKA-SHIBETSU
SHIBETSU
KITAMI-AIOI
ATTOKO
NEMURO
TOBETSU
OTARU
SAPPORO
KAMI-SHIHORO
KUSHIRO
IKEDA
OBIHIRO
TOMAKOMAI
HIGASHI-KUSHIRO
OSHAMAMBE
SHIZUKARI
HIGASHI-MURORAN
MURORAN
SHIZUNAI
HIROO
SETANA
MITSUISHI
URAKAWA
GORYOKWAKU
HAKODATE
ESASHI
KIKONAI
GOSHOGAWARA
KITA-KANEGASAWA
FUKAURA
IWASAKI
AOMORI
HACHINOHE
NOSHIRO
TAKANOSU
HANAWA
KUJI
ANIAI
TAIRADATE
KOMA
AKITA
KAMEDA
IWAYA
MORIOKA
YOKOTE
TOYOMANE
YAMADA
KAMAISHI
SAKARI
OFUNATO
ICHINOSEKI
YAHAGI
NEZUGASEKI
MURAKAMI
SAKAMACHI
SHIMOSEKI
NIIGATA
YAMADERA
SENDAI
MIYAUCHI
KAWAGUCHI
KANAMARU
YANAIZU
NISHI-WAKAMATSU
YUNOGAMI
TAJIMA
FUKUSHIMA
KAWAMATA
MATSUKAWA
KORIYAMA
WAJIMA
ANAMIZU
NANAO
TOYAMA
ITOIGAWA
TOKAMACHI
SHIOSAWA
ISHIUCHI
MINAKAMI
KANAZAWA
NECHI
MORIUE
OMACHI
NUMATA
TAKASAKI
YAMAGATAJUKU
FUKUI
SUGIHARA
TAKAYAMA
HAGIWARA
KOUMI
ONO
YORII
MITO
HOKUNO
YATOMI
MINOMACHI
KAMI ASO
TAJIMI
HIGASHI-HANNO
HACHIOJI
SAWARA
MATSUGISHI
MAIZURU
KYOTO
GIFU
OTA
AKECHI
KOBUCHIZAWA
KIYOSATO
GOSHODAIRA
YOKOHAMA
TOKYO
NAGOYA
SHIZUOKA
NUMAZU
KIBUKAWA
FUTAMATA
MANAZURU
ATAMI
USAMITOGE
NAKANO
OTAKI
OHARA
KATSUURA
EMI
KISARAZU
KURURI
KAMEYAMA
TOYOHASHI
HAMAMATSU
KAKEGAWA
NAGAIZUMI
MINUSE
OWASE
OKAGUCHI
MATSUSAKA
NARA
OSAKA
KOBE
HIMEJI
WAKAYAMA
MINOSHIMA
SHIGARAKI
TANABE
ASARAGI
NACHI
SHIMOZATO
TOYOOKA
TOTTORI
OKAYAMA
HIROSHIMA
YAMAGUCHI
SHIMONOSEKI
MASUDA
GOTSU
HAGI
KOGUSHI
SHIMYOICHI
MIYOSHI
KURE
HIRO
MIHARA
TAKEHARA
SAIDA
TAKAMATSU
HIKETA
OSAKA
IKEDA
TOKUSHIMA
MINAWA
NISHI-U
SAKO
YOSHINARI
KOCHI
KUSAKA
SUSAKI
YAMADA
OSUGI
IWAHARA
MATSUYAMA
KAMINADA
NAGAHAMA
UCHINOKO
YAWATAHAMA
TOKUYAMA
KUSHIGAHAMA
IMARI
YAMAGUCHI
MOJI
YUNOHIRA
BEPPU
OITA
SASEBO
NAGASAKI
SAGA
KURUME
ONOYA
ASAJI
KUMAMOTO
TATENO
MIYAJI
TAKAMORI
HINOKAGE
OKAMOTO
NOBEOKA
MINAMATA
KOMENOTSU
MIYANOJO
SENDAI
KAGOSHIMA
MIYAKONOJO
SHIBUSHI
UCHIUMI
IMAMACHI
MATSUYAMA
NISHI-MIYAKONOJO
HAYATO
KAGOSHIMA



Winter scene along electrified section of Joetsu Main Line, Niigata and Gumma Prefectures



Dumping gravel along new Gifu-Toyama line under construction through drifted snow at Takayama, Gifu Prefecture, February 23, 1931, completion scheduled for October, 1934

beautiful scenery. A remarkable panorama of the Sasagawa-nagare beaches is obtained.

The route crosses the plain of Shonai by way of the towns of Unzen-Ohyama and Tsuruoka, then finally converges with the former Shinjo line at Amarume. It branches off from the next station, Sakata, and passes through Kisagata, which is located at the foot of Mount Chokai, a volcanic cone rising near the sea.

Via Ugo-Honjo the Uetsu line follows a rugged gorge and passes through the Ohwatari tunnel (1.44 kilo.), the longest one along the route. Soon emerging into a wide expanse of sand dunes interspersed

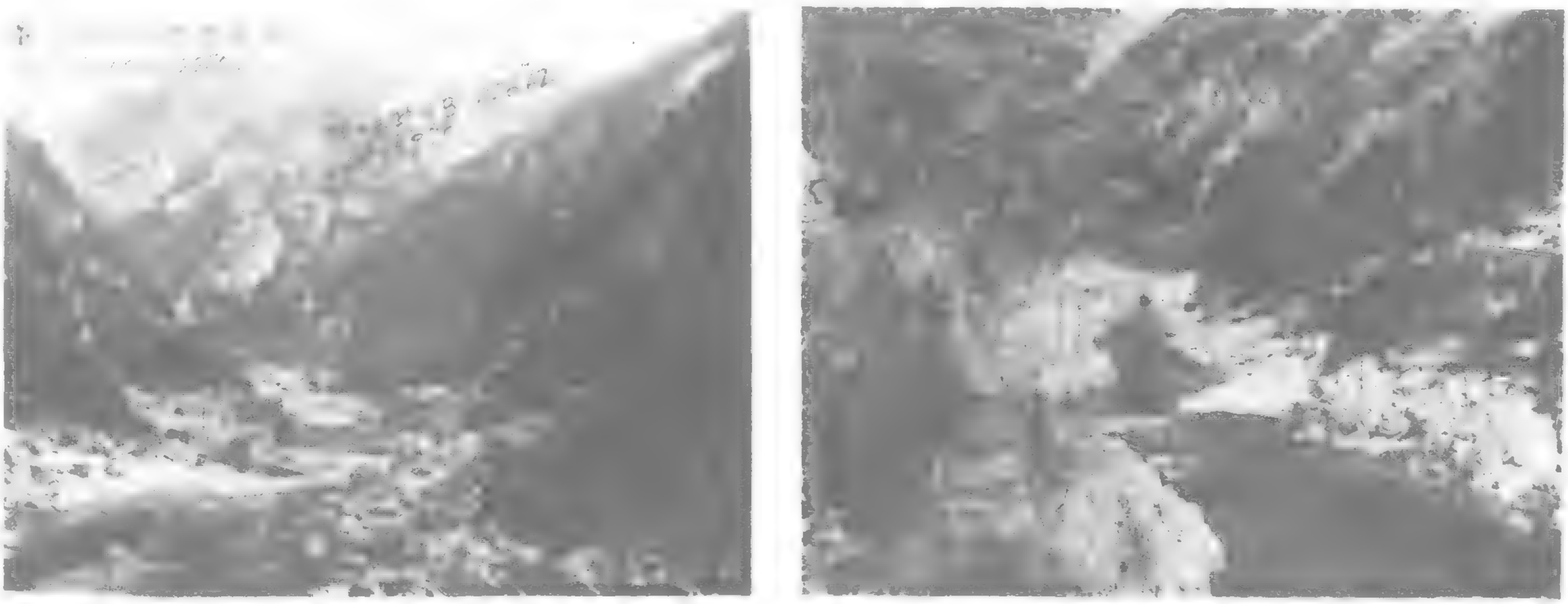
View of Murakami portal to Udomari tunnel (1,095-ft.) where it pierces a hard granite shoulder of the Japan sea coast between Samukawa and Katsuki, Uetsu main line linking Niigata and Akita Prefectures

by thickly wooded pinelands, the line spans the Omono River bridge (599 meters) and makes for its northern terminus at Akita, on the Omi mainline.

The Uetsu line, which penetrates the interior of Japan lengthwise and connects the Kansai (Central Honshu) and Hokkaido regions, is important as having been a means of bringing marked changes for betterment upon the government railway system of the country.

(2) *Oshawa Line.*— Islands of Hokkaido; opened to traffic in October, 1928: length, 77.17 kilometers.

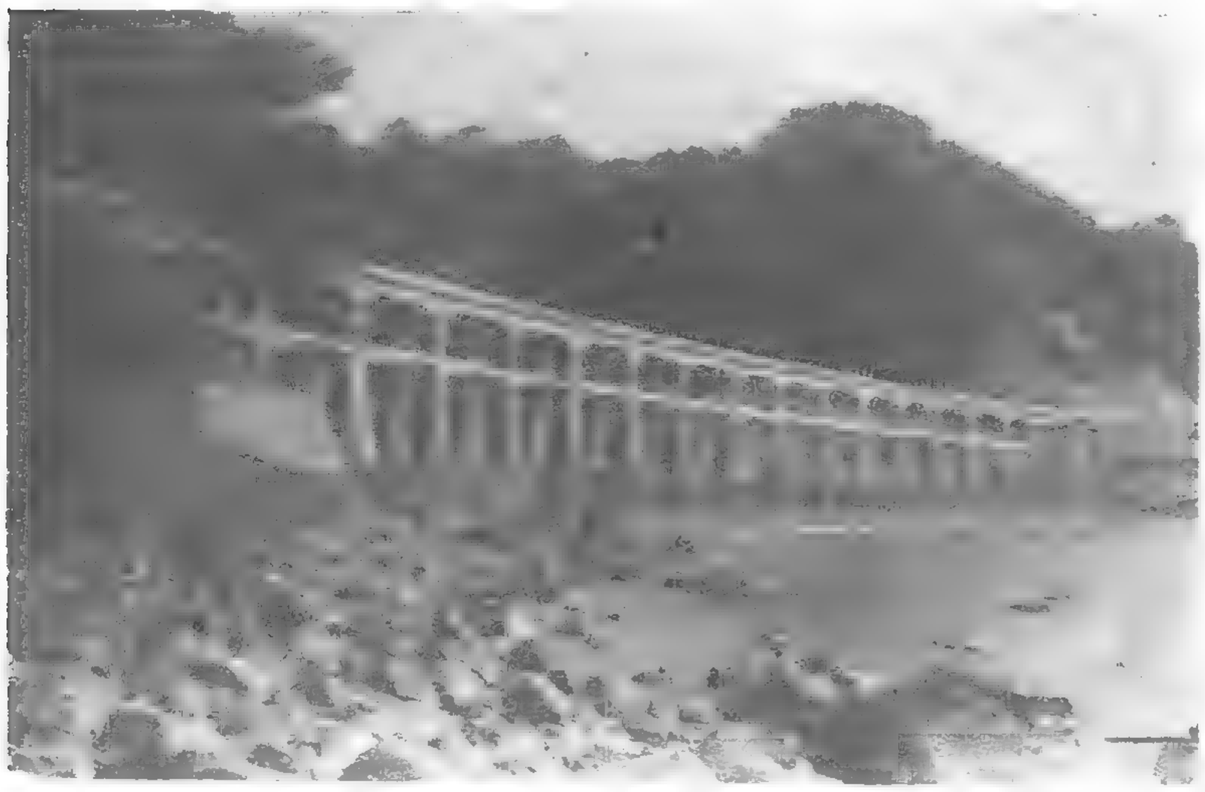
The Oshawa fork of the Hakodate mainline is a coast route



Above are shown two sites proposed for a railway trestle to span the Yoshino River, Tokushima Prefecture on the new Tosan Line which is to be completed in 1935

running between Oshamanbe and Muroran. From Oshamanbe, on the mainline, it turns off and follows the Uchiura bay front to Shizukari, going through eight tunnels having a total length of 7.38 kilometers. The course continues through numerous cliff formations where the foot of the mountains sink into the sea. Further on it skirts the scenic Reibun shore, from which may be seen the active volcano, Mount Komagatake. Then, via Bembe, Abuta and Moto-Wanishi, the Oshawa line connects with the town of Wanishi, on the Muroran mainline.

Formerly there was only the Hakodate mainline route to connect up the hinterland of Hokkaido and Japanese Saghalien with the main island of Honshu: but after connection of the Muroran and Hakodate mainlines between Oshamanbe and Wanishi, the heavy grade stretches were lessened as compared with the Hakodate mainline route. Although the distance between Oshamanbe and Iwamizawa was shortened by only 7.24 kilometers, about two hours running time is saved between these two points. Also, between Oshamanbe and Iwamizawa the Hakodate mainline



As trains cross the ferro-concrete Sohgo River Viaduct (624-ft.), Shan-in Line, passengers glimpse blue Japan sea waters rolling against a rocky shore line

Part of Figure 8 Looped roadbed near Shimidzu Tunnel (6.03 miles), Joetsu Main Line, in a Solfataric Hot Spring Region, which has many skiing slopes

Stretch of well-ballasted road bed built in virgin timberland along Sekihoku Main Line, Hokkaido, with distant view of portal of 2½ mile tunnel driven beneath ridge top which separates Ishikari and Kitami Prefectures

Where a retaining wall holds back collapsed portion of hill-side 23 miles from Murakami. Uetsu Main Line between Fuya and Nezumi-ga-Seki. In center background, south portal of Kurosaki tunnel driven through 211 feet of feldspathic granite

Electric train in mountainous region near Shimidzu tunnel (6.03 miles), Joetsu Main Line between Gumma and Niigata Prefectures

Long Ketosawa bridge structure spanning dry river bed on the Joetsu Main Line

and its Oshawa fork parallel each other. Nevertheless, by the opening of this line the system of train operation, the condition of freight traffic and the state of passenger travel in Hokkaido have been favorably influenced.

(3) *Hohi Line.*—From Ohita to Kumamoto, Ohita and Kumamoto Prefectures, Island of Kyushu; opened to traffic in December, 1928; length, 71.21 kilometers.

From Inugai, on the former Inugai line, the Hohi line, cutting a succession of sheer cliffsides, follows for a while the course of the Ohno River before spanning the turbulent Okudake River. Then climbing by way of Takeda and Tamarai, it crosses the boundary between Ohita and Kumamoto Prefectures, and gradually ascending the tableland, pierces the Saka-no-ue tunnel (2.28 kilo.), driven through the depression crater of Mount Aso into its deep barranco valley. Making a wide detour along the skirts of Aso's central cone, the Hohi line connects with Miyaji station, on the old Miyaji line, which was in the past the only railway serving the Aso valley plain.

This is the so-called *Trans-Kyushu Railroad*. It has improved passenger and freight service in the region, and at the same time has helped materially to develop both Ohita and Kumamoto Prefectures.

South portal to Manouchi Tunnel (313-ft.) excavated through formations of Basaltic Andesite about 22 miles from Murakami, Uetsu Main Line between Katsuki and Fuya. Here a sea wall protects rock-ballasted track bed against high tides. The small point of land in distant background, Benten Rock of Nezumi-ga-Seki

(4) *Joetsu Line.*—From Takasaki Gumma Prefecture to Nagaoka, Niigata Prefecture, Honshu (Main Island); opened to traffic in August 1931; length, 169.77 kilometers.

Starting at Takasaki, on the Shinetsu mainline, this route parallels the Ryomo line for a considerable distance. Then making a leftward turn along the Tone River from Shin-Maebashi, it continues via Shibukawa and Numata. After piercing the Shimidzu tunnel (9.702 kilo. or 6.03 miles), just under the steep summit of Mount Shigekura, which borders Kohzuke and Echigo, the line passes through Ishiuchi and Koide (both in Niigata Prefecture). Again it parallels the Shinetsu mainline from Miyauchi on and reaches Nagaoka, where it converges with both the Shinetsu and Uetsu mainlines. This is the shortest route between the Kanto region and the coastal districts bordering on the Japan Sea and the central part of Honshu.

Between the towns of Minakami and Ishiuchi the Joetsu line is electrified. Along other sections steam locomotives are used. Saving some four hours running time between Tokyo and Niigata, this line is shorter by about 98 kilometers than the Shinetsu line. The Shinetsu crosses the dangerous pass of Usui with an 941 meter elevation and heavy grade of 67 per cent; while the Joetsu is only 677 meters in altitude at its highest point, with only a 20 per cent gradient. Having the advantage of this reduced grade, there is a considerable difference in transportation capacity between the two lines.

In comparing the Joetsu route with the Banetsu line to Niigata, the former is 84 kilometers shorter and saves two hours and 40 minutes running time. In consequence, all freight and passengers, destined not only for Niigata and its vicinity but also for the Japan Sea coastal districts, are expected to take this route in preference, because it is faster and capable of a greater transportation capacity, notwithstanding its somewhat circuitous route.

Then comparing the Joetsu with the Ohu line, lying between Tokyo and Akita; though the route of this line (586 kilo) is 16 kilometers longer than the route via Fukushima (570 kilo.), the running time is one hour shorter.

In the last analysis, the opening of the Joetsu line has brought an advantageous change upon transportation facilities in Central Japan. By its superior carrying capacity and shortening of distances, it receives many passengers and much additional freight, which otherwise would be distributed between the Shinetsu, Ohu, Banetsu and Tohoku lines. Thus it fulfils its purpose as an important mainline.

Oval crested granite mound (Horai-yama) projecting some 300 feet into Japan Sea between Kuwa and Samu Rivers about 15 miles from Murakami, Uetsu Main Line. Here the winding coast line passes through two tunnels, Horai Nos. 1 and 2, 122 and 171 feet respectively

(5) *Sekihohu Line.*—Island of Hokkaido; opened to traffic in October, 1932; length, 75.54 kilometers.

Serving to extend the former Rubeshibe line from the town of Kamikawa, this line runs along the Rubeshibe River, passes through the Sekihoku tunnel (4.33 kilo.) and over part of the Kitami range of mountains which forms a natural boundary between Ishikari and Kitami Prefectures. *En route* it touches the towns of Maruseppu and Setose and connects with Engaru, on the Ybetsu line.

In linking Ishikari and Kitami Prefectures, Central Hokkaido is crossed by the Sekihoku line. It is the only short cut leading from the central or south-western portion of the island to the Kitami coast. When compared with the 214 kilometer

route leading from Asahigawa to Engaru via the Nayoro line, the Sekihoku line is 89 kilometers shorter and saves about three hours running time. Having brought substantial improvement to government railway operation in Japan, the Sekihoku line is useful from the standpoints of military, passenger and freight traffic.

(6) *Hagi Line.*—From Iwami-Masuda to Hagi, Yamaguchi and Shimane Prefectures respectively, Honshu (Main Island); opened to traffic in February, 1933; length, 60.66 kilometers.

This is the most recently completed of all the railway lines running lengthwise of and paralleling the hinterland of the south-west coast of Honshu. Starting at Iwami-Masuda, on the San-in line, it skirts the seashore by way of Toda-Kohyama, and through the Hotokezaka tunnel, which joins Shimane and Yamaguchi Prefectures, reaches Ezaki, a town reputed to have the most prosperous fishing harbor along this route.

The Hagi line passes through the famous Susa Bay district and on through the Ohkari tunnel (2.22 kilo.)—which is the longest on the line,—pierces the mountains at many places where they go down to the sea and reaches Sohgo beyond. Here a 189 meter ferro-concrete bridge is being constructed to span the mouth of the Sohgo River. Before crossing the Abu River and connecting with Hagi station, on the Nagato line, the course follows the Japan Sea coast via Nako.

With the opening of this new line, an uninterrupted run through southern Honshu was accomplished. It has brought satisfactory results to railway traffic regulation as well as to general transportation throughout the country.

Below is a complete list of the various railway lines and their lengths which have been built and put into operation throughout Japan proper, together with lines under construction and those projected for the future:

Lines Constructed within Past Decade		*Miles*
Kameda	Iwaya	4.4
Murakami	Nezugaseki	25.3
Kawashiri	Waka-Sennin	7.7
Matsuyama	Shibushi	10.6
Maizuru	Mineyama	30.3
Bihoro	Aioi	23.0
Kusaka	Yamada	20.1
Matsukawa	Kawamata	7.8
Obihiro	Kami-Shihoro	24.0
Toikambetsu	Wakkanai	50.8
Yonezawa	Imaizumi	14.4
Imabari	Matsuyama	30.8
Hinagu	Komenotsu	31.1
Kawaguchi	Tohkamachi	13.5
Tateno	Takamori	11.2
Shizukari	Wanishi	41.1
Ohta	Tajimi	11.0
Shoyama	Kurashiki	59.8
Asaji	Miyaji	24.8
Emi	Katsuura	18.3
Nagao	Haruda	12.9
Hachinohe	Kuji	37.1
Kamiiso	Kikonai	18.2
Kohge	Wakasa	12.1
Kogushi	Hagi	46.7
Oiwake	Niimi	33.4
Numata	Shiozawa	40.8
Higashi-Kushiro	Abashiri	103.3
Tairadate	Hanawa	34.5
Chizu	Tsuyama	25.4
Mineyama	Toyooka	21.9
Rumoi	Haboro	37.1
Rubeshibe	Engaru	46.9
Fukagawa	Shumarinai	49.1
Kunnui	Setana	30.1
Obihiro	Hiroo	52.4
Hayato	Nishi-Miyakonojo	26.3
Sawara	Matsugishi	21.8
Masuda	Hagi	37.7
Kami-Aso	Hagiwara	33.3
Ikeda	Minawa	2.5
Saida	Tsukuda	8.9
Yamada	Ohsugi	14.8
Kawasoe	Minose	28.0
Minoshima	Tanabe	43.4
Ohita	Onoya	13.7
Yunohira	Kita-Yamada	26.1
Kurume	Yoake	24.6
Toyama	Sugihara	28.4
Kamiyonai	Hiratsuto	24.5
Ichinoseki	Yahagi	49.7
Yamagatajuku	Tanakura	34.5
Asakanagamori	Kawahigashi	9.7
Noshiro	Iwasaki	29.4
Goshogawara	Kita-Kanegasawa	22.3
Wakamatsu	Yanaizu	20.8
Nishi-Wakamatsu	Yunogami	14.3
Nanao	Anamizu	22.0
Minomachi	Yatomi	24.7
Takamatsu	Hiketa	28.2
Sendai	Miyanojo	18.5
Matsuyama	Kaminada	14.0
Gotsu	Kawagoe	14.3
Shirakawa	Tenoko	7.1
Sakamachi	Shimoseki	7.1
Ohmachi	Moriue	16.6
Kojiro	Tojyo	12.0
Kisuki	Mitsunari	12.8
Imari	Imafuku	9.3

Lines Constructed within Past Decade		*Miles*
Kisarazu	Kururi	14.2
Ohara	Otaki	10.1
Matsusaka	Ieki	16.2
Himeji	Shingu	13.9
Mihara	Takehara	15.9
Kushigahama	Hanaoka	2.9
Marifu	Iwakuni	2.6
Yamaguchi	Hama	11.3
Sendai	Sakunami	18.0
Yabekawa	Yanagawa	5.5
Koumi	Sakuuminokuchi	5.7
Numata	Nakatoppu	21.8
Hachioji	Higashi-Hanno	16.2
Ono	Yorii	15.6
Nishi-Kagoshima	Goino	8.9
Tomakomai	Shizunai	49.8
Manazuru	Atami	5.4
	Total	1,997.2

Lines Under Construction		*Miles*
Hagiwara	Takayama	25.0
Minawa	Nishiu	7.9
Ohsugi	Iwahara	10.4
Minose	Owase	11.0
Nachi	Shimozato	3.7
Tanabe	Asaragi	11.3
Kita-Yamada	Hida	12.0
Yoake	Hida	5.2
Sugihara	Takayama	26.4
Hiratsuto	Toyomane	40.5
Yahagi	Ohfunato	14.4
Tanakura	Kawahigashi	19.3
Kita-Kanegasawa	Fukaura	14.6
Yunogami	Tajima	11.9
Anamizu	Mitsui	6.7
Yatomi	Hokuno	9.0
Hikita	Osaka	5.2
Yoshinari	Sako	2.1
Miyanojo	Tsuruta	4.6
Noda	Goh	3.4
Kaminada	Nagahama	10.0
Kawagoe	Kawamoto	7.1
Tenoko	Oguni	14.4
Shimoseki	Kanamaru	7.3
Moriue	Nakatsuchi	7.8
Itoigawa	Nechi	6.3
Tojyo	Yawata	4.3
Shohbara	Ochiai	15.2
Tohkaichi	Station	.6
Mitsunari	Yakawa	9.2
Imafuku	Mikuriya	8.6
Otaki	Nakano	6.6
Higashi-Tsuyama	Emi	13.3
Shingu	Sayo	14.9
Kure	Hiro	4.7
Takehara	Mitsuuchinoumi	11.9
Iwakuni	Hanaoka	21.7
Hama	Isahaya	26.4
Sakunami	Okunikkawa	3.1
Chitose	Yamadera	5.8
Yanagawa	Saga	9.4
Kobuchizawa	Kiyosato	11.0
Goshodaira	Sakuuminokuchi	4.8
Nakatoppu	Urausu	8.7
Sohen	Tobetsu	16.2
Higashi-Hanno	Yorii	23.2
Goino	Ohwatari	21.0

Lines Under Construction		*Miles*
Kibukawa	Shigaraki	9.3
Minamata	Kugino	9.5
Takanosu	Kanazawa	4.3
Attoko	Nakashibetsu	29.8
Shibushi	Imamachi	7.5
Shizunai	Mitsuishi	14.2
Kinomiya	Usamitohge	5.7
Ohi	Akechi	15.8
Takoh	Kisa	7.1
Fukuyama	Senda	3.1
Nobeoka	Okamoto	7.4
Horonobe	Furaoi	4.3
Kinonai	Uguizawa	9.3
Kakegawa	Haranoya	5.9
Atami	Nagaizumi	11.4
	Total	682.5

Projected Lines		*Miles*
Nishiu	Iwahara	6.9
Owase	Kinomoto	19.1
Kinomoto	Nachi	26.5
Shimozato	Kushimoto	12.9
Asaragi	Kushimoto	16.1
Toyomane	Kamaishi	26.6
Ohfunato	Sakari	1.9
Iwasaki	Fukaura	10.6
Mitsui	Wajima	5.9
Fukui	Kamianama	41.4
Hokuno	Kamianama	11.7
Osaka	Yoshinari	9.4
Sako	Tokushima	4.2
Tsuruta	Ohguchi	15.9
Nagahama	Noda	13.7
Goh	Yawatahama	1.9
Kawamoto	Miyoshi	42.6
Kanamaru	Oguni	5.5
Nakatsuchi	Nechi	11.3
Yawata	Ochiai	11.1
Shohbara	Tohkaichi	13.1
Tohkaichi	Miyoshi	.8
Yakawa	Ochiai	11.9
Mikuriya	Saseho	28.1
Kururi	Kameyama	5.5
Ieki	Okutsu	11.9
Emi	Sayo	10.3
Mitsuuchinoumi	Hiro	9.1
Okunikkawa	Akifu	2.9
Yamadera	Akifu	10.4
Kiyosato	Goshohira	8.3
Urausu	Tobetsu	22.5
Kugino	Yamano	10.7
Kanazawa	Aniai	16.4
Nakashibetsu	Shibetsu	6.2
Imamachi	Uchiumi	35.5
Mitsuishi	Urakawa	12.9
Usamitohge	Ito	1.8
Shiomachi	Takoh	.9
Kisa	Johge	10.5
Senda	Johge	26.6
Okamoto	Hinokage	17.6
Furaoi	Enbetsu	17.6
Uguizawa	Esashi	16.8
Haranoya	Futamata	12.0
Nagaizumi	Numazu	1.8
	Total	618.5

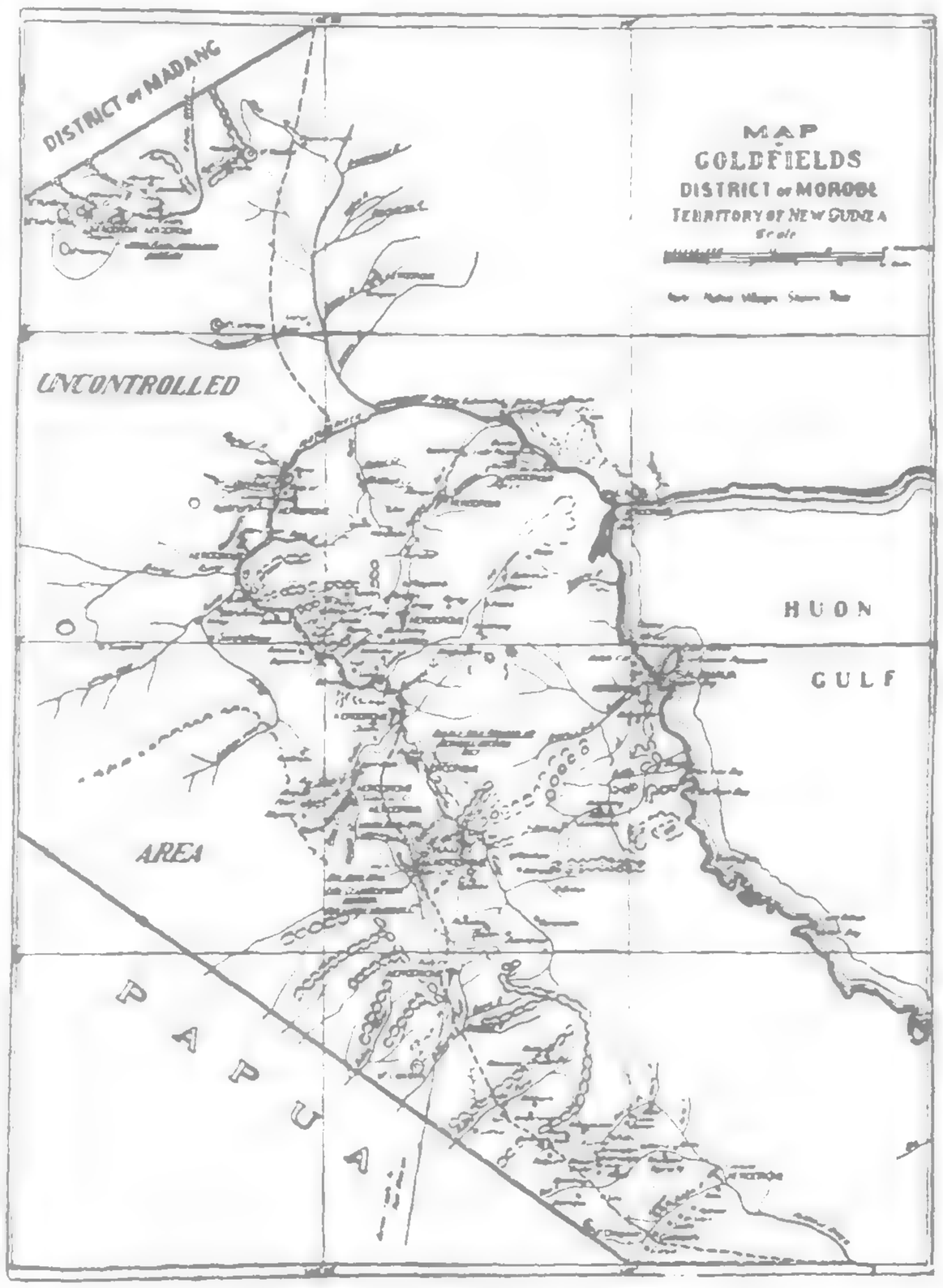
The Development of Gold Mining in Morobe, New Guinea*

By HAROLD TAYLOUR and I. W. MORLEY

SINCE the first discovery of payable gold at Edie Creek, mining on the Morobe Goldfield has shown remarkable progress, and, in spite of the tremendous natural difficulties, the field to-day ranks as one of the most important in Australasia. Aeroplanes, more than any other factor, have been responsible for this rapid development. They provide the only means of transport from the coast, and at present serve the needs of over 600 Europeans and 3,000 indentured native laborers engaged in the industry.

The first recorded evidence of the presence of gold in the island of New Guinea is that of Alvaro de Saavedra, a Spaniard, who sailed along the northern shores in 1528. In places he found traces of gold, and gave it the name of "Isla del Oro." Gold, in payable quantities, was not found until 1877, when discoveries were made in Papua and the Louisiade Archipelago. In German New Guinea (the present Mandated Territory of New Guinea), there was little active prospecting until 1896, when the German New Guinea Co. organized a party, under the leadership of Dr. Lauterbach, to prospect in the western tributaries of the Ramu River. Areas were subsequently taken up about nine miles up this river in latitude 5° 30′ south. Later, by arrangement, the German Imperial Government granted a concession to the New Guinea Company, and supervised the operations. The venture was fruitless, and after about ten years the concession was withdrawn. The expedition in 1899 of Lauterbach, Radalzt and Klink, these latter gentlemen having reported the existence of gold on the Ramu River, like the earlier one of Lauterbach, was without result, and the Ramu Goldfields Station was closed in 1902.

The discovery and production of the Yodda and Gira fields in Papua, near the southern border of the Morobe District, encouraged prospecting in the neighboring Waria River. And in 1906 a number of miners crossed the border and worked with fair success in German territory. In 1909 concessions were granted in this area to A. Kempf, and proposals were made for large scale operations. The area was reported on by Paul Schulze, Bergrat of Hindeburg, Silesia, who inspected properties on the Waria River in March—July, 1914. He estimated that there were some 900,000,000 cubic yards of wash available for hydraulic sluicing operations worth 4d. per cubic yard. Up to the present there has been no attempt to work these gravels on a large scale. The natives of the Waria River were apparently encouraged to work the beaches on the river for gold, which they sold to the New Guinea Co. at Morobe. A German expedition into the Markham and Watut Rivers in 1913 was also reported to have found gold. A. Darling, a Papuan prospector, also penetrated across the border, prior to the World War, and made discoveries of payable gold on the Bulolo River, near Koranga Creek. It was on the basis of Darling's report that W. ("Shark-Eye") Park made his find on the Koranga in 1922. Gold was also reported in the Sepik River area and New Britain during the German règime.



Morobe Goldfield

This field has almost exclusively provided the gold production of the Territory. Prior to December 31, 1926, it is variously estimated that between £50,000 and £100,000 worth of gold was produced. From January 1, 1927, to June 30, 1932, the production was worth £1,352,479 (Australian currency). The field comprises the south-easterly portion of the Morobe District, an area of about 4,400 square miles. For the most part it is covered with heavy forest, and situated at an altitude of between 2,000 and 8,000 feet.

Subsequent to the War, and the establishment of the Mandate in 1921, interest was renewed in the Waria River area. A number of dredging leases were tested by Messrs. J. C. Coldham and B. V. Barton, mining engineers, who represented influential Australian interests. The comparatively low values and the transport difficulties at that time prevented further development. Recently work has been commenced again on the Waria River, but until the last few years the richness of the Edie Creek—Bulolo River has attracted most attention.

In 1921-1922, W. Park relocated A. Darling's discovery on Koranga Creek. After making several trips up the rugged jungle-covered Francisco and Bitoi River valleys, he crossed the Kuper Range, which runs up to an altitude of some 10,000 feet, and came into the Bulolo valley. The cost of transport and supplies, the time taken to reach Morobe, which was then the nearest port, and the inaccessible nature of the country, prevented much notice being taken of this find, although parts of the Koranga Creek bed were very rich. Park is said to have recovered an average of 20 ozs. per day with a few native laborers. By the end of 1923, there were 17 miners on the field. Work was confined to the washing, by primitive methods, of the rich alluvial gravels of the Koranga and Bulolo, and desultory prospecting of the surrounding area. The difficulties of transport and communication were so great that nothing less than 10 ozs. per day was considered payable. All supplies had to be carried in by natives.

During the years 1924 and 1925 activities on the field increased considerably, and a large number of "dredging or slucing" leases were taken up. By the end of the latter year there were some 50 miners and prospectors with their native labor teams on the field, and prospecting and some alluvial mining was in progress at intervals along the course of the Watut and Bulolo Rivers and their tributaries. Not many of the miners were obtaining

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profitable returns owing to the high costs, and much alluvial ground that was then abandoned is now being worked.

The find that first caused world-wide notice was made in February, 1926, when W. G. Royal and R. M. Glasson, two Australian prospectors, succeeded in reaching the upper waters of Edie Creek, a tributary of the Bulolo River, and at an altitude of some 6,500 feet (the Bulolo River is at an elevation of from 2,000 to 3,500 feet) they discovered very rich auriferous gravels in the creek bed and banks, running in patches up to £200 per cubic yard. This find caused a rush to this part of the field, and by the middle of 1926 there were some 100 miners and their native laborers on Edie Creek. The influx to the field at this stage was reminiscent of the early Australian "gold rushes." The conditions at Edie Creek at this time are difficult to realize. The ground was heavily timbered and covered with moss, the weather intensely cold, by comparison with the coastal climate, wet and miserable. The men and natives were living in rough sapling shacks or tents. Rice cost up to £4 a 50 lb. bag (one bag of rice would last 25 natives for one day). Nevertheless, the richness of the ground was still attracting more prospectors. The new port, Salamaua, was established as the Administration center, and a wireless station erected there in November, 1926.

The end of 1926 saw the first operating companies formed to exploit portions of the alluvial gravels. The late C. J. Levien formed, with Adelaide associates, Guinea Gold N.L., which took control of a large group of leases in the Koranga and Bulolo areas, and commenced active mining and testing operations. The leases of the Royal-Glasson group were also formed into a company, later to become Edie Creek Proprietary Ltd., and hydraulic sluicing and elevating plants were installed.

On April 18, 1928, the initial aeroplane flight to the goldfields (from Lae to Wau) was made by Lieut. E. A. Mustar in a D.H. 37 aeroplane owned by Guinea Gold N.L. This was the pioneer of the present aeroplane service to the field by Guinea Airways, Ltd., which is now the largest aerial freight-carrying organization in the world. The first trip cost passengers £33 per head—at present the cost is £5.

In May, 1927, another phase of mining was entered on, when a gold-bearing vein of quartz, associated with the oxides of manganese, was discovered on the Royal Lease, Upper Edie Creek. This vein is now known as Edie Lode No. 1. This was soon followed by the finding of the now well-known Day Dawn vein, near the Merri Creek—Edie Creek junction. These discoveries resulted in intensive prospecting and, by the end of the year, several hundred gold mining leases had been applied for. Most of these were optioned to London interests. Testing of the Bulolo leases was continued during the year, but in view of the high transport costs, dredging proposals were not proceeded with.

During 1928 and 1929 prospecting and work by alluvial miners was continued on a smaller scale, and the development of the veins and dredging areas continued. A large operating company, New Guinea Goldfields, Ltd., was formed under the aegis of the Mining Trust, Ltd., to work the greater part of the Edie Creek, Koranga Creek, Namie Creek and Upper Bulolo River areas, both for alluvial and veinstuff. Placer Development, Ltd., a Canadian company, took options over Guinea Gold N.L.'s Bulolo dredging areas and tested them, showing 40,000,000 cubic yards of an average value of 2s. 4d. (gold at normal prices) per cubic yard.

The year 1930 saw the commencement of construction for dredging operations on the Bulolo River by Bulolo Gold Dredging, Ltd., a subsidiary of Placer Development, Ltd. The same year saw the proving of 100,000 long tons of 10dwts. (gold at normal prices) ore by New Guinea Goldfields, Ltd., at Golden Ridges, near Namie Creek. Day Dawn (New Guinea), Ltd., was formed to work the Day Dawn vein. A new find was reported at Black Cat Creek on the coastal fall of the Kuper Range, and a mild rush resulted. Payable alluvial gold was also discovered in the Upper Ramu River area, and this was declared a provisional goldfield. Elsewhere on the field alluvial mining and prospecting continued on a limited scale.

In May, 1931, the first ore was milled at Day Dawn, whose mill has been in continuous operation since that date. Three-engined (G.31) Junkers aeroplanes, with a pay load up to 7,000 lbs. were introduced. New Guinea Goldfields, Ltd., and Bulolo Gold Dredging, Ltd., continued to instal power plants, dredges and other machinery (all transported from the coast by aeroplane). The gold production increased considerably as a result of the exchange premium received.

On March 21, 1932, the first dredge commenced operations at Bulolo. In August, 1932, the first cyanide mill in the Territory started up at Golden Ridges. The success of the operations conducted by Bulolo Gold Dredging, Ltd., and Day Dawn (New Guinea) Ltd., attracted considerable attention, and large areas were taken up as dredging claims or gold mining leases in all parts of the field. The month of November provided the record production to date of the field, for any one month, being 18,610 ozs. of bullion, valued at £88,792 (Australian currency).

Production

Prior to July 1, 1931, accurate figures of production, checked against mint returns, were not kept. For the period January 1, 1927, to June 30, 1931, the figures are, nevertheless, reasonably accurate. Production, previous to 1927, is estimated, and is probably on the low side. Owing to the variation in the Australian-sterling exchange, a premium was received on the gold from the middle of 1930 onwards. And subsequent to August, 1931, the price of fine gold (sterling) has increased, owing to the variation in sterling-gold exchange. All figures are given in Australian currency unless otherwise stated.

TOTAL GOLD (BULLION) PRODUCTION OF THE MOROBE GOLDFIELD DURING THE AUSTRALIAN MANDATE

Period	*Amount in Gold (approx.)*	*Fine Oz. Silver (approx.)*	*Value Gold £ (approx.)*	*Value Silver £ (approx.)*
Prior to 31/12/26 (estimated) ..	11,765	10,860	50,000	1,470
1/1/27 to 30/6/28 ..	100,365	92,640	426,552	10,191
1/7/28 to 30/6/29 ..	44,277	40,870	188,176	4,360
1/7/29 to 30/6/30 ..	30,254	27,930	128,580	2,452
1/7/30 to 30/6/31 ..	29,858	25,000	154,046	1,060
1/7/31 to 30/6/32 ..	63,485	36,000	434,352	2,710
Totals	280,004	233,300	£1,381,706	£22,243

The production for the six months July 1, 1932, to December 31, 1932, was 74,732 oz. of bullion, valued at £343,698. It is estimated that the production for the twelve months ending June 30, 1933, will be worth £750,000. It is considered that the production for the period from July 1, 1933, to June 30, 1934, should exceed £1,000,000 in value.

FINENESS OF GOLD—VARIOUS LOCALITIES. (APPROXIMATE)

Locality	*Fineness (Gold) per 1000.*	*Value of Gold, at 85s. per fine oz.* s.	d.
Upper Edie Creek	522.1	44	5
Lower Edie Creek	626.8	53	4
Bulolo River	638.1	54	3
Koranga Creek			
Upper Watut River	834.6	70	11
Lower Watut River	740.0	62	11
Black Cat Creek	855.0	72	8
Upper Bitoi River			
Upper Ramu River	939.2	79	0

Topography

Mining is chiefly centered in the District of Morobe (see Map), where two proclaimed goldfields are situated, and to a lesser extent in the District of Madang. A small amount of mining is also being carried on in the islands of New Britain and Bougainville, in the Districts of New Britain and Kieta respectively. The chief feature of the Morobe District is its mountains, many of them very high and steep, intersected by deep valleys and covered with a dense growth of forest and jungle. As may be expected from its tropical situation, heavy rainfall, and high mountains, this portion of New Guinea is particularly well supplied with rivers and watercourses.

The main trend of the mountains throughout New Guinea in general, and the Morobe District in particular, is north-east, south-west, and constitutes the principal orographical feature of the island.

The Krätke mountains in the northern portion of the District reach a height of about 10,000 feet, and lie to the west of the upper valley of the Markham River. To the north-east of the Upper Ramu River is the Finisterre Range, the highest points of which are about 13,000 feet. The Rawlinson Range to the south of the Finisterres has a maximum height of about 7,000 feet. Further south again, and separating the valleys of the Bulolo and Watut Rivers from the coast, is the Kuper Range, with forest-clad summits up to 10,000 feet. Other ranges to the south and east rise to 9,000 feet above sea-level.

Although the Morobe District is one of high relief, it does not necessarily follow that the conditions for mining by means of adits is all that may be desired. Rock exposures are few, and the whole terrain is covered by a dense mantle of vegetation: consequently prospecting is slow and costly.

Safe harbors for shipping are available in Salamaua and at Morobe. The goldfields' shipping is at present handled from Salamaua and Lae, both of which townships are also air-ports for the mining centers. Lae is located on the open coast, near the mouth of the Markham River, and while it provides an excellent air-port, it is unsafe for shipping. Many thousands of tons of heavy mining machinery and supplies have, however, been lightered ashore at Lae, and from there flown to the inland mining areas.

Salamaua, which lies about twenty miles to the south of Lae, provides both a good shipping and air-port, and is the chief seaport of the goldfields. At present no wharfage facilities are available at Salamaua, therefore all cargo from the overseas ships must be lightered ashore. Port and harbor improvements are now under consideration for Salamaua. The aerodrome at Salamaua is at present inferior to that at Lae, and is not suitable for the large freight-carrying planes of 7,000 lb. capacity now flying between Lae and the inland aerodromes. This aerodrome, however, lends itself to improvement, and, if and when required, may be made suitable for the accommodation of the heaviest type of aircraft now in use in New Guinea.

The rainfall throughout the goldfields area varies considerably from point to point, and at different times of the year, but, generally speaking, there is usually an abundant supply for mining purposes, except in the higher altitudes, where the catchment is small, and the run-off rapid. Although the rainfall is normally high, periods of drought have been known in the Territory.

Few countries are better equipped than New Guinea for the development of hydro-electric power. In the goldfields area there are numerous streams flowing along steep gradients and between steep walls. Mining interests are utilizing this source of energy for their operations.

Climate and Health

The Territory of New Guinea has a moist tropical climate, the mean average temperature on the coast being about 78° F. to 85° F. There is no cool season; rain falls in all months, and the humidity is high, averaging about 75 per cent: the climate is consequently enervating to Europeans.

Above an altitude of 2,500 feet conditions become better, and a mild bracing climate is encountered. On the whole, the climate throughout the goldfields is good. At Edie Creek, altitude 6,000-7,000 feet, English vegetables grow to perfection, and provide very necessary articles of diet, which is a great factor in the maintenance of good health amongst the European population. Day temperatures at Edie Creek are pleasantly warm, but at night time the temperature falls considerably and log fires are in demand in the dwellings. The coldness of the Edie Creek climate may be imagined when it is realized that from four to five blankets are required to keep one warm at night.

As most of the auriferous areas in the mountains, at elevations above 200 feet, the climate on the goldfields may be regarded as a healthy one, and suitable for large white populations. In common with all tropical countries, however, reasonable precautions must be taken for the preservation of health, and by observing ordinary care persons of good constitution, who pay careful attention to diet, exercise and hygiene, are able to maintain good health.

At the higher altitudes, particularly at Edie Creek, the highest point at present where mining is in progress, the native laborers are more or less subject to outbreaks of pneumonia and dysentery. Efficient medical services, however, minimize the effect of these occurrences.

The anopheles mosquito, which causes the spread of malaria, is known to exist in the goldfields area up to 3,500 feet altitude, therefore most white residents living between this elevation and the coast take the precaution of sleeping under mosquito nets, in addition to taking a daily dose of five grains of quinine.

Communications

Communication between the goldfields and other parts of the world is now fairly good, compared with what it was in the early days of mining in New Guinea. At Salamaua, Wau, Bulolo and Lae wireless stations maintain contact with the outside world. Between the coast (Salamaua and Lae) the outlying centers of the goldfields are served by efficient aerial transport services, organized and conducted by private enterprise. The only telephone services on the goldfields are those erected and controlled by the mining companies for their own use.

Apart from the aerial services, the principal means of moving about the goldfields is on horseback or on foot, over rough mountain tracks. Only a few miles of road exist at the present time and these have mainly been constructed by mining companies for the transport of machinery and supplies.

For mining and general structural purposes the district is well supplied with a variety of good timbers. These represent a great variety of species and generally consist of a commingling of Australian and Asiatic types. Various classes of semi-hardwoods are extensively used for timbering purposes in underground mining work. Great care must be exercised in the selection of mining timber, as some varieties decay very quickly when used underground.

Geology

The writers have had no opportunity of doing any geological field work in New Guinea, and realize that these few notes are nothing more than a bare outline of some of the geological features. So far as they know, nothing has been published on the geology of the Morobe Goldfields. There is, therefore, much scope for scientific and economic research.

The main geological feature of the island of New Guinea is a very high range of mountains, or rather, series of ranges, extending from the north-west to the south-east of the island. This cordillera, or backbone, as it were, consists principally of an Archaean complex of metamorphic and intrusive rocks, flanked on either side by a wide range of deposits which pass into the most recent sediments.

The highest peaks of the cordillera are in Dutch New Guinea, where altitudes up to 16,000 feet have been measured. At these altitudes snowfields and glaciers exist. In the Morobe District the Finisterre mountains are probably the highest, where heights of over 13,000 feet have been reached.

Many of the high mountains are capped with Tertiary coraline limestones, while the beds of the streams flowing from these ranges are littered with the products of denudation; consisting largely of schists, phyllites, slates, gneisses, indurated sedimentaries, granites, diorites, gabbros, and dark fine-grained basic instrusive rocks, and in some cases agglomerates, andesites, rhyolites, and basalts.

It is obvious that earth movements on a colossal scale have taken place in comparatively recent times, to raise to 16,000 feet the marine strata now found at these elevations. The stupendous folding movements which tended to overturn New Guinea on the Australian continent were responsible for the formation of the main mountain ranges of the island, paralleling as they do the long axis of New Guinea. The greatest epiorogenic earth movements probably took place during late Teritary times, and were accompanied by violent outpourings of lava, closely followed by considerable orogenic movements.

The auriferous deposits of New Guinea occur mainly in the metamorphic complex of the cordillera, and are genetically associated with intrusive granites, porphyries and diorites.

In New Guinea generally, there is a commingling of Australasian and Asiatic geological and biological types: but in the goldfields area of the Morobe District, the absence of palaeontological evidence makes the classification of the various series a difficult matter.

That faulting and rifting took place on a gigantic scale in New Guinea is evidenced by the great rift valleys extending for many miles through the Waria, Bulolo, Watut, Markham, Ramu, and Sepic River valleys. When viewed from an elevation of about 10,000 feet, the profile of the main ranges of the Morobe

District suggest the existence of an uplifted, and highly dissected, or block-faulted peneplain.

Rock Types in the Goldfield

Only the more important rock types associated with the ore deposits will be described under this heading.

(*a*) *Shales, slates and phyllites.*—This series is well developed in the Wau-Edie Creek mining center, and is the prevailing rock type in this area. The Edie and Wau Creeks and other small streams on Mount Kaindi, have cut their channels through much of these formations. The shales and slates are predominantly of a soft mature, and dark in color. The term shale as used here refers principally to the softer formations, while slate is used to distinguish the harder and more siliceous varieties. Fissility is generally poorly developed, although in many cases the original stratification and planes of schistosity are distinctly visible. The slates generally contain varying quantities of iron sulphides, in which cases the rock is usually harder.

The series as a whole is very much contorted, and dips at steep angles; in many cases the dip is almost vertical. It is with these rocks that the lodes of the Day Dawn mine at Edie Creek are chiefly associated.

(*b*) *Mudstone or mudrock.*—There is a large development of this rock in the upper Edie Creek area. It is usually very soft, buff to light reddish in color, and weathers rapidly to a soft argillaceous mass. In some places this rock is tuffaceous in character, exhibits a stratified appearance, and is probably a metasomatically altered schist. It is generally sufficiently soft, where encountered in the underground workings, to be mined with a small quantity of explosives. In fact, in many of the wetter workings, it becomes very troublesome, and is known to the miners as "running mudstone," or as "swelling ground." Only the most skilled miners can successfully deal with and timber this ground.

A number of silico-manganiferous veins are being developed in this formation by New Guinea Goldfields, Ltd., at Edie Creek. Edie Creek, altitude 6,000-7,000 feet, roughly follows a well-defined fault, which marks the junction between the slates on one side and the mudrock on the other.

(*c*) *Porphyry.*—This is a quartz-felspar-porphyry, and occurs at Edie Creek as irregular-shaped masses, intruding the slates, phyllites and mudstones. At and near the surface it is usually very much kaolinized, and is of a buff color, and generally of a soft nature. Where penetrated in the deeper mine workings it is harder, less decomposed and of a bluish color. In the more decomposed state, nearer the surface, it is often troublesome in the wet mine workings, where careful timbering is necessary.

The auriferous veins are intimately associated with porphyry intrusions, which occur as apophyses from the bathylithic granite-masses lying in a general southerly and westerly direction from Mount Kaindi, in which the Edie Creek ore deposits are being worked and developed.

While the above-mentioned rocks are the principal types represented in the auriferous areas now being worked, a great variety of sedimentary, metamorphic, and igneous rocks, ranging from Recent to Pre-Cumbrian, are to be seen throughout the district; their description is, however, beyond the scope of the present paper.

Glacial and Alluvial Deposits

The gold-bearing detrital deposits occurring along the valleys of the main streams are very extensive, and are probably accounted for by the country being one of very high relief combined with a high rainfall. Much exploratory and testing work is required before anything approaching an approximate estimate can be made of the extent of the workable alluvial deposits, at present known to exist. The valleys of the Bulolo and Watut Rivers, and their tributaries, have, so far, been the most important centers for the mining of alluvial gold. As far as the authors know at present, the gravels of these streams have been enriched by the denudation of the quartz and manganese veins and "leaders" occurring in the higher portions of Mount Kaindi. The richness of the present alluvial deposits of Edie Creek, the neighboring streams, appears to be largely due to a reconcentration of the gold previously contained in old glacial streams.

While considerable alluvial deposits occur throughout the Morobe and Upper Ramu goldfields, no reefs or lodes have as yet been discovered, other than those on Mount Kaindi, to account for the alluvial gold.

The alluvial deposits have much in common with gold placers found elsewhere, but probably the low specific gravity of much of the locally-won gold renders its extraction more difficult.

The wide distribution of alluvial gold throughout the Morobe District encourages prospectors to go further afield in search of new deposits. It may be safely said that there are few countries at present which offer more favorable unexplored territory to the experienced gold prospector, than does north-east New Guinea.

In some of the country drained by the Waria River belts of serpentine occur, and it is in these localities where osmiridium is found, and from time to time worked.

The metal won from the alluvial gravels and veins of Edie Creek usually assays 53 per cent to 57 per cent gold and 47 per cent to 43 per cent silver. Some of it is of even lower value, assaying only 35 per cent to 40 per cent gold. On the other hand, metal from the Upper Watut and Bitoi Rivers assays as high as 80 per cent to 96 per cent gold. The chief characteristic of the metal is its high silver content, and consequent low specific gravity. Silver is the chief "impurity," there being little or no base metal present.

Practically all gold won is exported to Australia, the parcels usually consisting of:—

(*a*) Alluvial grains, dust, nuggets and slugs, which vary considerably in physical characteristics. Some are solid, others porous and spongy, or resembling tiny fern leaves. Others again appear to have coalesced by a process of cold welding during concentration in the places.

(*b*) Waterworn stones, usually well rounded, with the gold appearing to have been well beaten into the surface. In some cases these "specimens," as they are referred to by the miners, consist of two outer layers of quartz with the gold in between. They have obviously been eroded from small leaders in the quartz veins.

(*c*) Melted gold, which is very little different in appearance from ordinary bullion, except perhaps that it is more "brassy" in color, due to the large amount of silver present.

The alluvial gold found in some localities is very difficult to amalgamate, due probably to some superficial coating, as after boiling in dilute acid the gold amalgamates quite readily. In the final cleaning of the boxes and sluices much "black sand" is cleaned up with the gold. This consists principally of magnetite, some chromite, hornblende, garnets, etc., and in a few localities, cinnabar. The largest nuggets so far found in the placers have weighed between 300 and 400 ounces, and have consisted largely of quartz.

Ore Deposits

The ore deposits at present known to exist are located on the upper and lower slopes of Mount Kaindi, and may be conveniently and briefly described under: (*a*) The Edie Creek Area: and (*b*) The Golden Ridges Area.

(*a*) *The Edie Creek Area.*—The ore deposits in the Edie Creek Area are being worked and developed at elevations of between 6,000 and 7,000 feet above sea level, and have been mainly opened up by adits driven along the strike of the veins.

Of the veins so far developed some occur in slate, others in mudrock and others again in porphyry. In all cases the veins occur as fissure-fillings, and are generally steeply inclined, and vary from about 2-ft. 6-ins. to 5-ft. 0-ins. in width. A characteristic of all the veins in the oxidized zone, which in some cases extends to over 300 feet below the surface, is their association with the oxides of manganese.

At the time of writing (January, 1933), only one vein—and that on the Day Dawn mine—has penetrated the sulphide zone. Where exposed, this lode consists of hard brecciated quartz and slate, highly impregnated with pyrites, and showing free gold.

While a small amount of post-mineral faulting has been encountered in the mine workings, most of the fissuring and faulting appears to have taken place before the deposition of the ore.

The lodes generally exhibit a banded structure of quartz and manganese oxides. Some contain a rubbly, saccharoidal quartz with high percentages of manganese and iron oxides; others contain little manganese and consist principally of hard, massive, iron-stained quartz. Small quantities of calcite, rhodonite and rhodochrosite are occasionally met with in the ore channels.

(*b*) *The Golden Ridges Area.*—In this locality an orebody is being worked by New Guinea Goldfields, Ltd., at an elevation of about 4,000 feet above sea level. The orebody occurs as a flat-lying deposit, and is situated near Wau, on the foothills of Mount Kaindi, overlooking the Bulolo River valley. This more or less horizontally disposed deposit averages about 18 feet in thickness, and is overlain by an altered clayey breccia, averaging some 20 feet in depth. No data are available as to the composition of the ore. other than that it consists principally of manganese oxides and quartz, and is associated with porphyry and volcanic breccia. It occupies a rounded spur, and is drained on two sides by Namie Creek and several smaller creeks, all of which contain auriferous gravel. A deposit of crystalline limestone has been opened up close to this orebody and is being mined by open-cut methods, for use in the cyandie plant treating the Golden Ridges ore.

Legislation

Legislation in the Territory is introduced in the form of Ordinances, which are promulgated by the authority of the Governor-General of Australia. Regulations and rules subsidiary to the Ordinances are introduced by the Administrator of the Territory. Legislative and Executive Councils are now being formed, which will give a form of limited self-government, and will have power to introduce Ordinances.

Mining operations in the Mandated Territory of New Guinea are controlled by the provisions of "The Mining Ordinance, 1928-1932," and the "Mining Regulations." This legislation is based on "The Mining Act, 1898," of Queensland.

The small miner usually takes up ground as a Claim (other than a Dredging Claim), while the company will hold its property as Leases or Dredging Claims. Areas may also be taken up for the erection of machinery, erection of furnaces, stackings of tailings, working of "puddling" ground, working of auriferous sands from milling plants, market gardens, business purposes, and residence purposes. Water rights may be granted to the holders of Miners' Rights for mining or general purposes (including power generation). There is a fee of £2 per two cusecs for every water right applied for to work a claim, but any quantity of water may be granted, for the same fee, for lessees or for general purposes. All gold won from the Territory is subject to a royalty of 5 per cent of its realized value (this values does not include the return received from silver, or shipping, insurance, or realization charges on the fine gold). Provision is made for mining on reserves, residence areas, business areas, alienated lands and native lands. It may be noted that the metric system has been adopted by the Territory for all measurements of length or quantity.

"The Gold Buyers' Ordinance, 1931" regulates the purchasing of gold within the Territory. All gold buyers have to be licensed and submit returns of gold purchased. This was introduced as a measure to prevent gold stealing, from which trouble the Territory has, to date, been singularly free.

Under "The Customs Tariff Ordinance, 1922-1927," there is an import duty of 10 per cent on all mining machinery or aeroplanes imported into the Territory. Few imports are free from duty, which is usually at the rate of 10 per cent, but there is no income, land, or poll tax in the Territory. All immigrants entering the country are required to enter into a bond for £30 each to ensure that they will not become a charge upon the Administration.

Labor

On the goldfields of New Guinea the labor employed may be divided into three main classes, as follows: (*a*) European, (*b*) Native, and (*c*) Asiatic.

European labor in the mining areas is predominantly Australian, and is occupied principally in a supervisory capacity; but, owing to the low order of mentality of the aboriginal native (by far the largest numerically employed on the goldfields), much manual work is carried out by the Europeans. All skilled work, such as carpentering, blacksmithing, mechanical work, engine-driving, etc., is the work of Europeans, each of whom is supplied with native laborers as helpers.

The policy of the New Guinea Administration is against the introduction of foreign colored labor into the Territory; consequently, industry depends for its supply on the native races, which belong to the stocks known as Melanesians, Papuans, Polynesians and Micronesians.

There is an extraordinary diversity of tongues amongst the native races of New Guinea and the neighboring islands, so much so that different languages, between which there is no clear relationship, are encountered in small neighboring regions. This fact makes it impracticable for the Administration, dealing as it does with the Territory as a whole, to establish a common native language. The lingua franca of the Mandated Territory is "pidgin" English, which is admittedly a rather horrible jargon, and while it probably will in time be replaced by English, it at present serves the needs of the Territory.

The total native population of the Mandated Territory is as yet unknown, as there are still large areas unexplored, but known to be populated. The total, however, would be not less than approximately 400,000.

Native labor for the mining areas is generally engaged under the indenture system, is drawn from various parts of the Territory, and may only be recruited by a person into whose employment the native is to come, or by his licensed agent. Under the indenture system the native, after being passed as fit by an Administration medical official, "signs on" for a period of service up to three years. At the completion of his service he is again medically examined, and, if certified as fit, is sent home by his employer. If the laborer is found to be not in a fit state to be sent home, he is to receive medical attention at the expense of the employer until his condition is satisfactory. The minimum monthly wage for a male laborer is five shillings a month; and for a boy under sixteen years, four shillings; and the maximum is ten shillings, unless the native has special qualifications. It is unusual for a native to receive more than ten shillings a month; but a few can earn more. These rates probably seem very low, but the needs of the natives are few, and the employer must, in addition to wages, provide him with food, blankets, shelter, medical attention, etc.

Raw "kanakas" recruited for the first time are of a very low order of efficiency, and usually cannot speak or understand "pidgin," but quickly show an all-round improvement in physical fitness after a few months of work and regular feeding. In cases were natives have been specially trained, they have shown, for a primitive race, quite a surprising capacity for the assimilation of useful knowledge. The hours of labor for natives engaged on mining and porterage are 48 per week, while those for general laborers are 55 per week.

The few Asiatics who are on the goldfields are employed as cooks, and occasionally as carpenters and plumbers, while others find employment as tailors or traders. They are not encouraged to engage in gold mining and none is so employed.

Mining Practice

Alluvial Mining.—The principal centers of alluvial mining in the field are on the Upper Watut and Bulolo Rivers and their tributaries, Surprise Creek, Roaring Creek, Iroa Creek, Little Wau Creek, Koranga Creek, Namie Creek and Edie Creek. Alluvial gravels are also mined by hand methods on the Upper Bitoi River and its tributary, Black Cat Creek. The Upper Ramu River area has lately attracted attention, and deposits of alluvial wash payable by hand methods have been found in the tributaries of that river.

(*i*) *Prospecting.*—Prospecting for alluvial gold is usually prosecuted by individual miners. The system of creeks and rivers form a basis for the search, the prospector commencing at the mouth of a river system and working upstream testing the bed and banks with a dish. In the country to the west of the Kaindi Range (the Bulolo-Watut divide) prospecting is somewhat restricted, since that area is "Uncontrolled Area" (*i.e.*, the natives in that area are still somewhat hostile and have not yet been brought under control by the civil administration). All Europeans entering that area must be holders of "Uncontrolled Area Permits."

The individual usually reconnoitres the area of country he considers promising by making a "flying trip" through it with a small team of natives. If the dish prospects are sufficiently encouraging he will then return to his base, and after equipping himself with stores for some months, return to his "prospect" and establish a camp, and probably gardens, for himself and his laborers.

Dish-prospects are only regarded as approximate, and the miner instals a "box" at the first opportunity to test the gravels thoroughly. Prospecting boxes are made some 8 feet long by 12-ins. wide by about 8-ins. deep. The top and one end are not covered. The box is installed at a slope of about 1 in 12. The bottom of the box is lined with riffles of various types, and from $\frac{1}{4}$ to $\frac{1}{2}$ a cusec of water is run through the box. If it has been impossible to carry a box to the prospect, trees are cut down, adzed, and a box made, or the tree is hollowed out and used as a box. The gravels are dug by the native laborers, from five to eight for a "box-team," and washed through the box. At the end of the day (eight to ten hours) the box is "washed up," and the concentrate in the riffles cleaned. With such a team from $\frac{1}{2}$ to 1 oz. of gold (in the form of dust or flakes) is considered payable. Generally speaking, payable gold means the recovery of sufficient gold to pay current wages to the European miner working the ground, plus wages and "keep" for his native labor team. The market price of gold, the fineness of the gold from various parts of the field, and the transport cost to the locality will, of course, affect the payability.

Having proved the payability of the gravels, the prospector will apply for the area under a suitable title.

The greatest part of the Bulolo and Watut Rivers have been prospected and occupied in a manner similar to that outlined above. The enhanced price of gold during the past two years has caused attention to be paid to many lower-grade properties in all parts of the district, and some previously declared to be "unpayable" are now showing handsome returns.

(*ii*) *Box and Dish Mining.*—To date, approximately 75 per cent of the total production of the field has been produced by this primitive method of mining, usually in conjunction with "ground sluicing." These are among the simplest methods of alluvial mining known, but are not often seen in the more established mining fields. Their principles are well described in "Prospecting for Gold," by Ion L. Idriess. These methods are only applicable in river or creek beds, beaches or low terraces.

(*iii*) *Hydraulic Sluicing and Elevating.*—Hydraulicing has been adopted, where possible, on the various terraces throughout the field. The largest individual producer by this method is Koranga Gold Sluicing, Ltd., a small privately controlled Sydney company, which holds a group of lease at the head of Koranga Creek. It is operating three monitors under heads varying from 100 to 200 feet on the terraces on the sides of the creek. The values are somewhat irregular, but an average production of some 300 ozs. of bullion per month is being obtained. The gravels broken down by the monitors are washed through sluice boxes some 30 feet long and three feet wide, and the larger boulders are removed by blasting and manhandling by native laborers.

At Edie Creek there are several high terraces that have been worked by similar methods. The greater part of the terraces still unexploited is now held by New Guinea Goldfields, Ltd., and this company is now concentrating on working out the creek-bed. When this is completed, they propose to sluice the terraces, and deposit the tailings, in the creek-bed. In connection with their elevating operations this company also uses monitors to wash the gravel to the elevator-throats. The same organization is also operating nozzles on terraces of wash on Namie Creek and the Bulolo River, near Koranga junction, under heads of 100 to 150 feet.

Large-scale hydraulic sluicing operations were commenced at the beginning of 1933 by the Upper Waria Syndicate, on the high banks of alluvial gravels on the Upper Waria River, near Garaina. In view of the enormous deposits of alluvial gravels in that district the results of the syndicate's work are attracting much notice, as this is the first serious attempt that has been made to work these terraces.

Several individual miners on the field have installed home-made sluicing plants to enable them to work the terraces on their properties. The comparative cheapness of such plant, its portability, combined with the ample water power available in most parts of the field, make it very suitable for the individual or small syndicate.

The only elevators at present operating on the field are those of New Guinea Goldfields, Ltd., which has three 4-in. jet elevators working in the bed of the Upper Edie Creek below and above the Merri Creek junction. The wash at this part of the creek is somewhat shallow, being only from six to 12 feet deep; in addition, the gutters are in places very narrow, consequently the plant has to be frequently shifted. Several of the smaller operators are installing or proposing to instal small elevating plants in various parts of the field.

(*iv*) *Gravel-Pumping, etc.*—To date, no gravel-pumps, drag-line excavators, or other similar machinery has been installed in connection with alluvial mining on the field. There are several deposits of gravel that could be worked most suitably by these methods.

The gravel-pump particularly has attracted attention, and such plants will be installed on various properties on the Bulolo, Upper Watut, Lower Watut, and Upper Ramu Rivers during the coming year. In addition, leases are being tested on the Bulolo and Lower Watut for large-scale company work, with 10-in. gravel pumps.

The richer gravels being now worked out, the smaller miners throughout the field are paying attention to the lower-grade properties that can be worked profitably by small mechanical plants, and the next few years should see a large increase in the machinery installed on the field. The simple water-wheel coupled to an electric generator is the most favored type of prime mover for these plants.

(To be continued)

Railway Axle Plant for Russia

(Continued from page 547)

Grinding Machines

During the finishing operation material can be left on the journal or wheel seat for a final grinding or burnishing operation, although with tungsten carbide tools the finish obtainable is such that these operations are superfluous. If it is preferred to grind the journals for the "final finish," the double-ended grinding machine shown in Fig. 1 is provided. This machine is also of the centrally controlled semi-automatic type, with two independent grinding heads controlled by one lever at the front of the machine. The grinding heads are provided with hydraulic transverse motion for traversing the grinding wheel quickly to and from the work. Both grinding wheels are mounted on one saddle with longitudinal traverse and operate simultaneously on the journals. An interesting point in this connection is the provision of a traverse mechanism, which enables the complete journal right up to the radii and shoulder of the axle to be ground without any adjustment. The in-feed of the wheels is automatic, and when their work is completed the grinding heads are traversed clear to allow the free positioning of the next axle. The axle is driven from the center hollow spindle driving head by means of a floating driver, and special micrometer direct-reading caliper gauges are provided at each end of the machine for checking the ground journals. These gauges are always in position, and if it is found that one grinding wheel wears more than the other, resulting in a difference in the diameters of the two journals, a simple correcting adjustment is made. Diamond truing devices are fitted on each tail-stock for imparting the true shape to the wheel. The operations on this machine can be carried out in 12 minutes.

Bailey Furnaces in Japan

As an indication of the activities of Babcock and Wilcox Ltd. in the Far East, it is of interest to note that the capacity of the 33 "Bailey Furnace"-equipped boilers in Japan, Korea and Manchuria exceeds $5\frac{1}{4}$ million pounds of steam per hour. Of these boilers, 18 are installed in industrial plants and 15 in central stations, three of the latter being fired with Babcock "Style 28" stokers. The remainder are all pulverized-fuel-fired, six plants being direct fired and four fired on the storage system.

All the pulverized-fuel-fired furnaces are of the hopper bottom type, with the exception of six in the industrial class which are slag tap. Babcock milling and burning equipment supplied in connection with the above comprises 42 "Lehigh" mills, four Fuller-Bonnot mills and nine Babcock tube mills, together with 70 "Lodi" burners, 42 "Calumet" burners, and eight cross-tube burners. The Babcock and Wilcox associates in Japan are Toyo Babcock K.K. of Yokohama.—*British Engineers' Export Journal.*

New Motor Vessels in Service in China

THE Whangpoo Conservancy Board, Shanghai, has put a motor vessel in service for carrying cargo on the Whangpoo and Soochow Creek. It is 54-ft. long and displaces about 45 tons when carrying a load of 20 tons. At the trials the vessel (Fig. 3) which is equipped with an airless injection four-cylinder Sulzer Diesel engine developing 50 b.h.p. at 550 revs per min., attained a speed of 8.1 miles per hour, the guaranteed speed being 6.5 knots. When travelling at full speed it can be brought to rest in about 40 seconds.

Another vessel put in service at Shanghai is the passenger boat *Soy Yun* (Fig. 1), for conveying workmen and other employees between the dock and vessels under repair. It is in service for about eight hours daily. The vessel, which is 44-ft. long and has a speed of nine knots, was built by the New Engineering and Shipbuilding Works and is equipped with a 160 b.h.p. airless-injection three-cylinder Sulzer Diesel engine.

Fig. 1.—Tug Boat "Soy Yun," built by the New Engineering and Shipbuilding Works, Shanghai, and propelled by one Sulzer Marine Diesel Engine, 160 b.h.p. at 375 r.p.m.

The same company has also put the tug *Geisha* into service, which is subject to very severe manœuvring service on the Whangpoo and is preferred to other vessels equipped with hot bulb engines on account of its being quickly ready for service. The vessel (Fig. 2) has a length of 61-ft. and is equipped with a 160-b.h.p., airless-injection Sulzer two-cycle Diesel engine which gives it a speed of 9.4 knots.

Fig. 2.—Motor Tug "Geisha" propelled by a Sulzer Airless injection 2-cycle Diesel engine developing 160 b.h.p. at 375 r.p.m.

Fig. 3.—Motor cargo boat of Whangpoo Conservancy Board, Shanghai, propelled by a Sulzer 2-cycle Airless Injection Diesel Engine Type 4-RKW-15, developing 50 b.h.p. at 550 r.p.m.

Railway Construction in Hunan

About $6,600,000 is to be spent on the Paoking-Hungkiang light railway, in Hunan province, out of a loan of $10,000,000 to be raised shortly. Two-thirds of the proceeds are to be used for the repair and completion of the Paoking-Hungkiang Railway, and will be controlled by a Special Custody Committee in order to prevent funds being appropriated for other uses.

Surveying of the route of the railway, as well as all matters relating to planning and technical affairs, shall be undertaken by the Ministry of Railways. The Ministry shall appoint competent men to take charge of the engineering work for repair and completion of the railway.

In case of necessity, the Ministry of Railways shall have the right to take over the railway upon payment of equitable compensation to the Provincial Government.

A set of general principles governing the flotation of the Hunan Provincial Reconstruction Loan was adopted at a meeting on October 18, of the Central Political Council. Following is a summary of these principles :—

(1) The amount of issue shall be fixed at $10,000,000.

(2) One-third of the total proceeds shall be used for the repayment of previous loans granted by the banks; and the remaining two-thirds for the repair and completion of the Paoking-Hungkiang light railway.

(3) Interest shall be at the rate of 6 per cent per annum.

(4) The principal of the loan is to be entirely redeemed within a period of ten years.

(5) The revenues accruing from the Provincial Business Tax and Certificate Tax in southern Hunan shall be earmarked as primary security; and the earnings of the Paoking-Hungkiang light Railway as secondary security for the repayment of the loan.

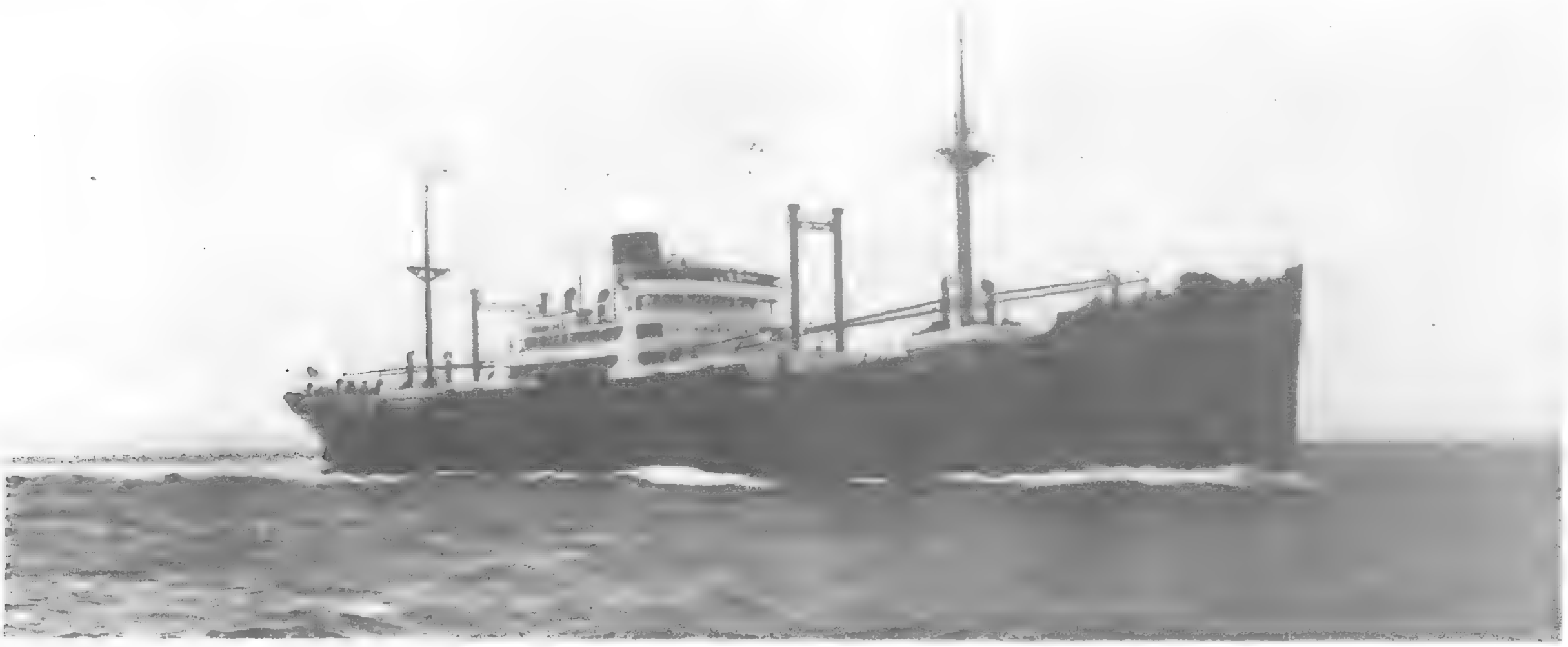
The amounts required for the service of the loan shall be deposited regularly with the Bank of China, Bank of Communications, Shanghai Commercial and Savings Bank, and Provincial Bank in southern Hunan to the account of a Sinking Fund Committee, composed of Government officials and financial and industrial leaders designated by the Executive Yuan.—*Chinese Economic Bulletin.*

The New Motor Cargo Vessel "Uyo Maru" of the Toyo Kisen Kabushiki Kaisha

With the construction two years ago of two motor cargo ships, the *Soyo Maru* and *Ryoyo Maru*, each of 9,100 tons deadweight, the Toyo Kisen Kabushiki Kaisha, inaugurated the formation of its motor fleet, and with a view to expanding and supplementing it, the Company later on placed an order with the Nagasaki Shipyard and Engine Works of the Mitsubishi Zosen Kabushiki Kaisha for the construction of four vessels of 10,000 tons deadweight to be fitted with Mitsubishi M. S. Diesel engines.

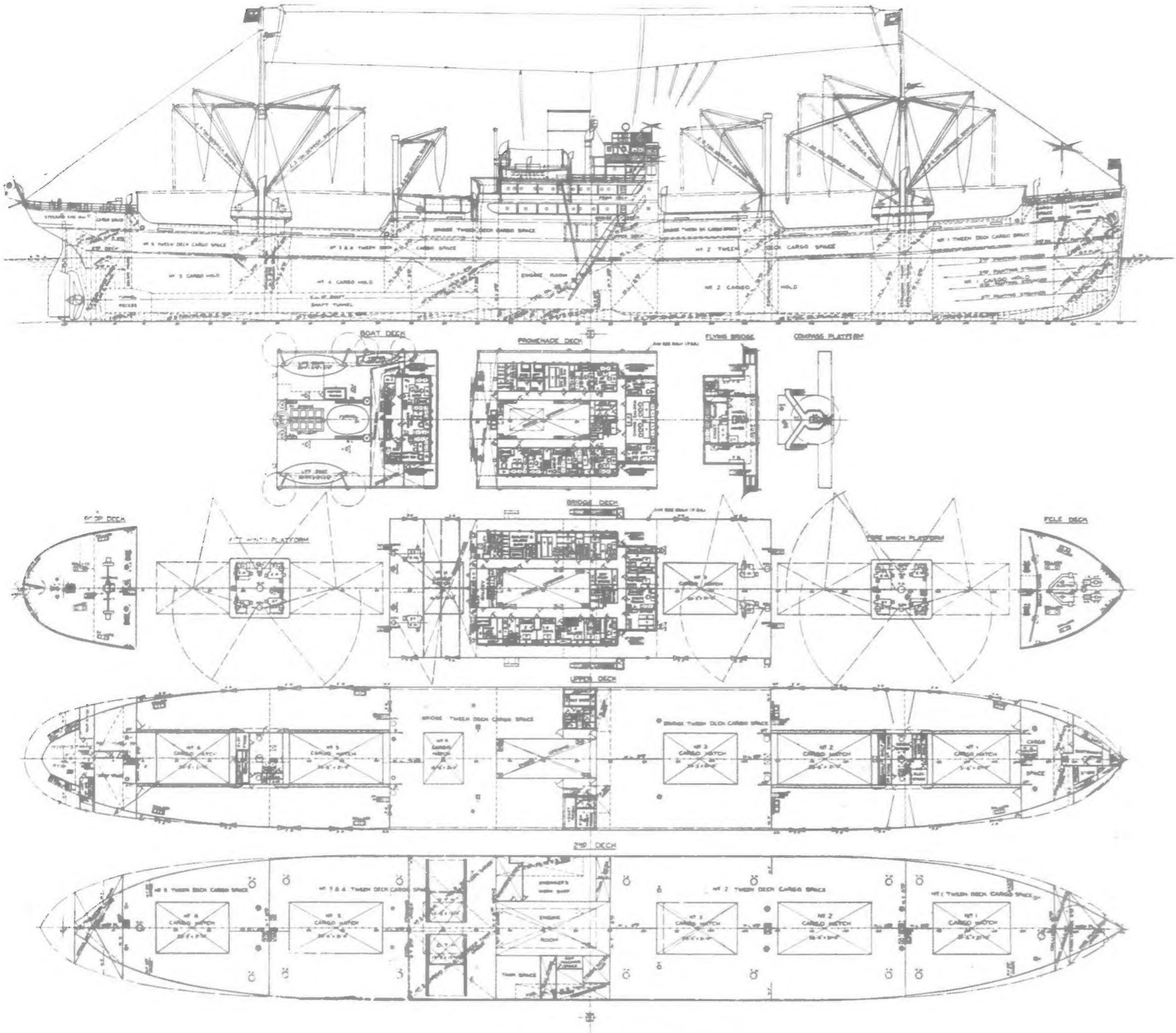
The first of these four sister ships, the *Uyo Maru*, was completed on October 3, this year, and after finishing her maiden voyage to North America, during which eminently satisfactory operating results were achieved, she is now homeward bound.

The second vessel, the *Nichiyo Maru*, and the third ship, the *Getsuyo Maru*, now in course of construction, are making satisfactory progress, and will shortly be completed in succession, to be put into commission, it is anticipated, during the first half of the coming year. As the present vessel, together with the other three, will form excellent units of the latest type in the motor fleet planned by the owners to take an active part in the shipping trade every consideration has been given to the design of the vessel, which embodies all improvements and the result of experience gained through the operation of the former ships, the *Soyo Maru* and *Ryoyo Maru*, and accordingly it can rightly be claimed that the vessel leaves nothing to be desired as a grain and lumber carrying vessel on the Japan-North American run. She is of the same type as the *Koryu Maru* and the *Kosei Maru* of the Hiroumi Shoji Kaisha, and the *Koei Maru* of the Takachiho Shosen Kaisha, with the exception of the type of main engine installed in the *Koryu Maru*, which is a Mitsubishi-Sulzer 6ST68, all built and engined at the Mitsubishi

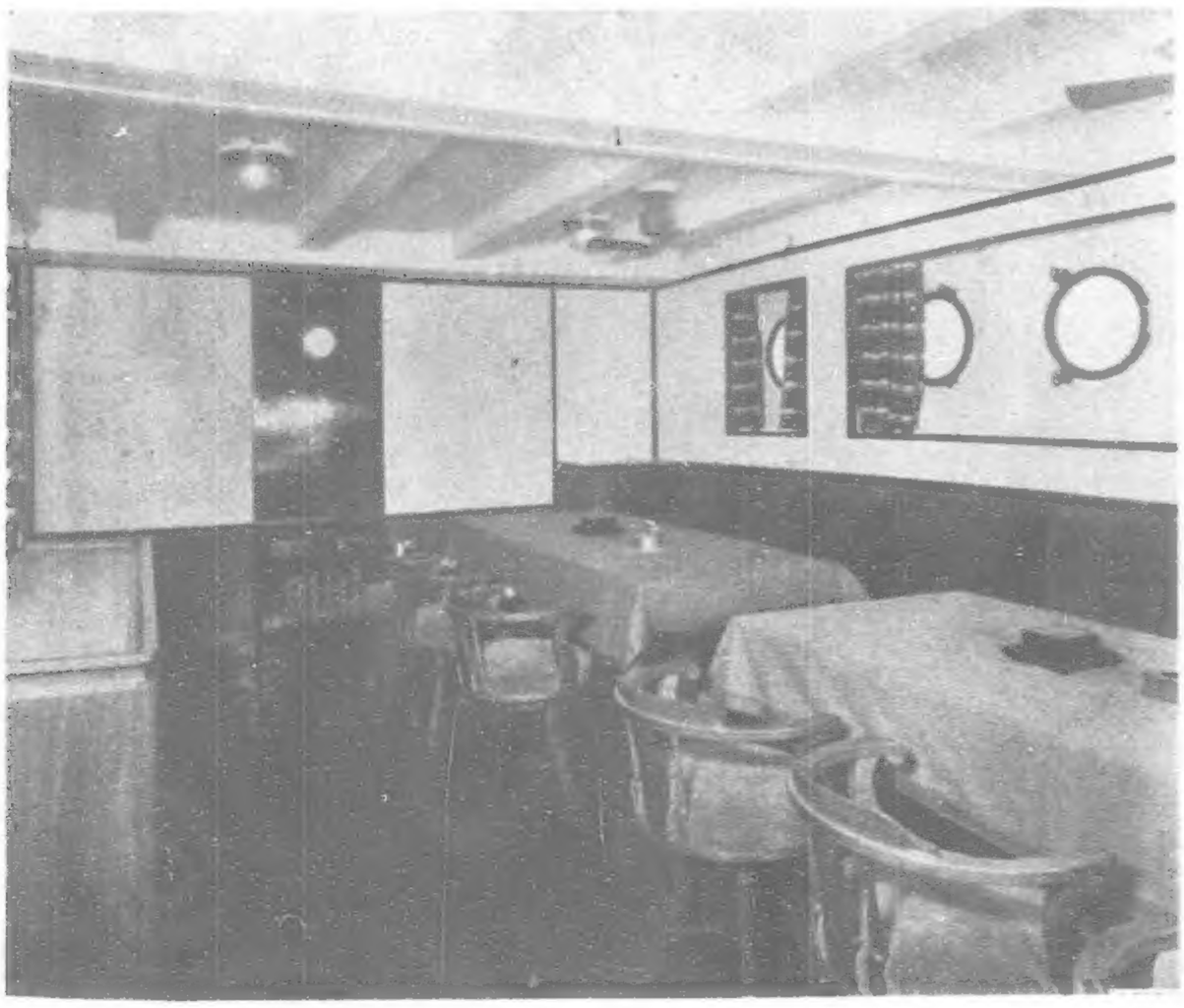


The new motor vessel "Uyo Maru" on her trial runs

The "Uyo Maru" as she appeared at pier when receiving finishing touches



The "Uyo Maru"—General Arrangement



The dining room

Owners' room

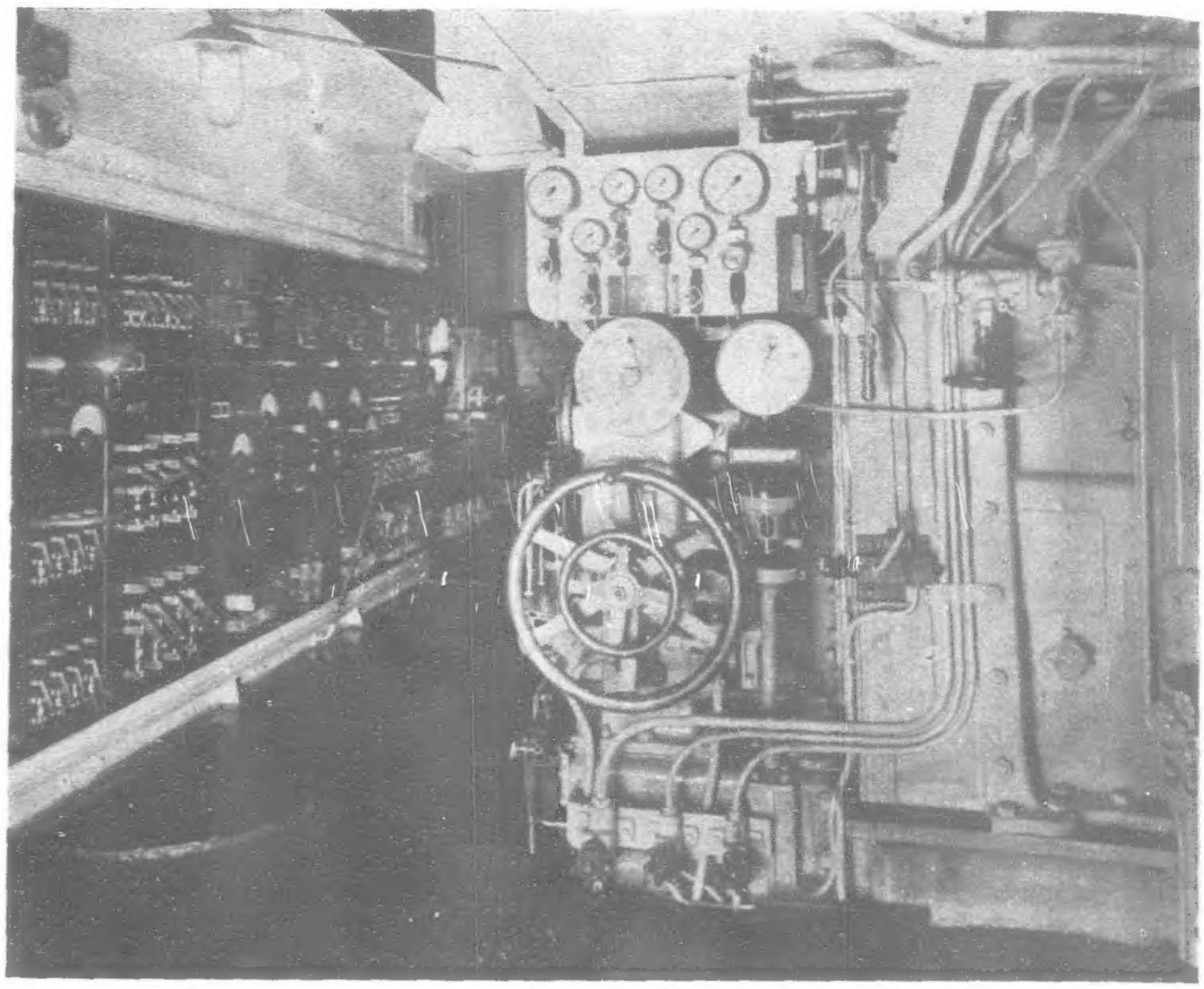
Nagasaki Shipyard & Engine Works, but in order to provide an increase in the cargo carrying capacity, the bridge deck has been extended aft, making all the space under that deck a cargo space, with the exception of small sections retained for provision stores and a refrigerated provision space. This amendment permits of an increase of about 630 tons in her cargo grain capacity.

The crew's quarters are usually located under the bridge deck in such type of vessels, but in the *Uyo Maru* they are arranged on the bridge deck for the benefit of the crew. Consequently, the decks amidships have been increased by one, which is a promenade deck with a saloon. This necessitated the wheel house, etc., being placed high, which renders the manoeuvering of the vessel convenient, and at the same time gives the vessel a stately appearance, in combination with its huge funnel and pleasing shade of paint.

To give a few details of the vessel, it may be said that she has been built under Teishinsho special survey in accordance with the regulations governing first class vessels, and also under Lloyd's special survey, and is classed ✠ 100 A.1., as well as ✠ L.M.C. To permit of the transport of lumber, the upper deck and bulwarks have been sufficiently strengthened. Middle line bulkheads are fitted in the holds and 'tween decks in lieu of pillars to suit grain cargo.

In view of the discussions which have taken place of late as to the panting stress at the fore part of ship's bottom in motor vessels, special attention was given by the builders to this part, and it was made of very robust construction. The fore and aft water tanks are divided into upper and lower tanks for the convenience of ballast trimming. The fore deep tank is built as an oil tank. The principal particulars of the vessel are as follows :—

Length between perpendiculars.. ..	435-ft. 0-in.
Breadth moulded..	58-ft. 6-in.
Depth moulded to upper deck	32-ft. 10-in.
Full load draught	26-ft. 3-in. (about)
Deadweight carrying capacity	10,000 tons
Gross tonnage	7,504 ,,
Maximum mean speed on trial	16.213 knots
Corresponding power	4,987 b.h.p.



Manoeuvering platform and Switch-board of the "Uyo Maru"

Cargo handling appliances of the vessel include :—

Twelve electric winches supplied by Mitsubishi Electrical Engineering Company, Limited, of which four have a lifting capacity of five tons, and the others three tons.

Twelve derrick booms of Mannesmann tube, mounted on the masts and derrick posts, of capacities of three, five and 10 tons. These have been procured from Messrs. Stewart in England.

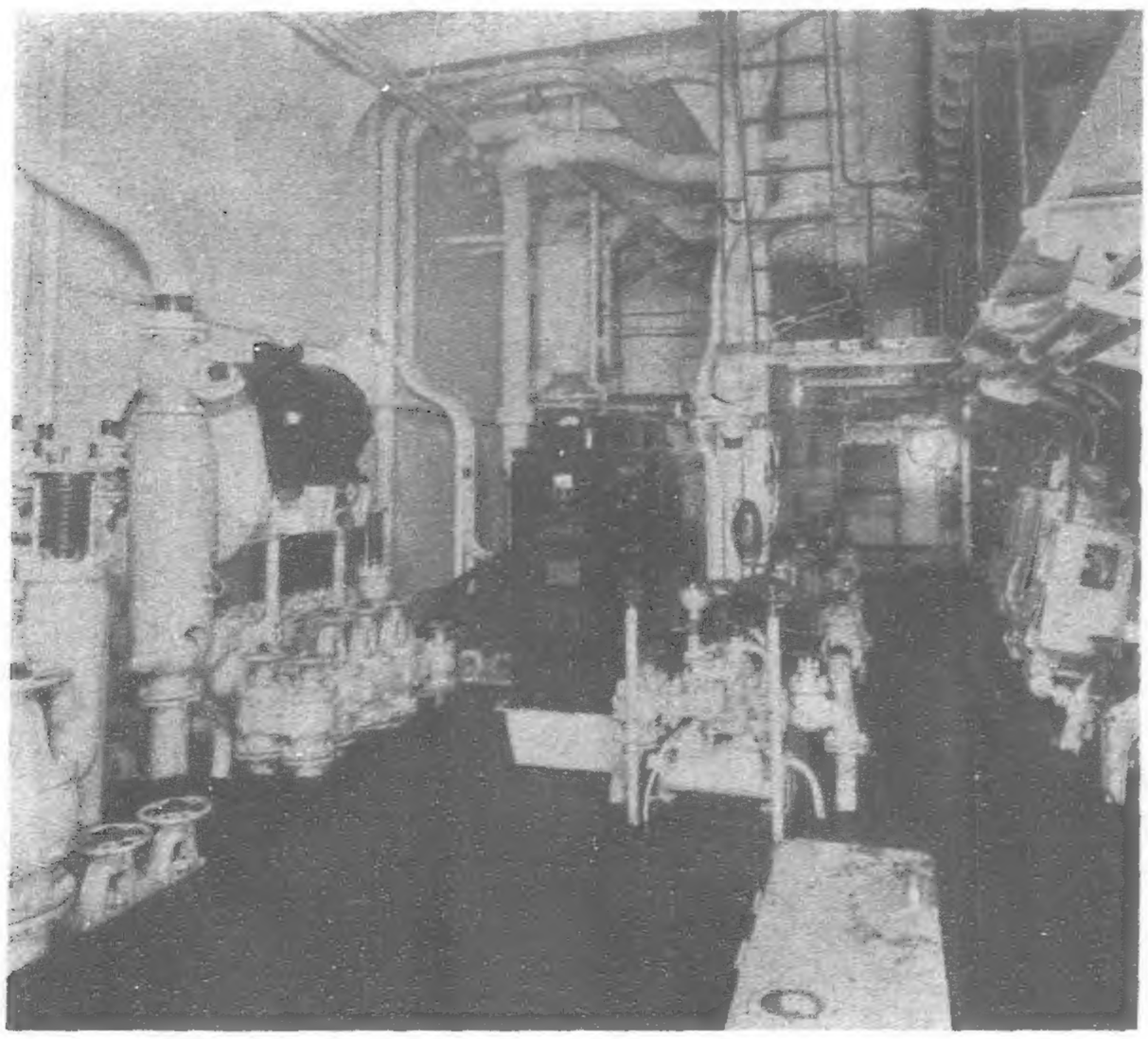
Other deck machinery is also electric driven, manufactured by :—

Windlass—Mitsubishi Shipyard & Engine Works, Hikoshima, and Mitsubishi Electrical Engineering Co., Ltd.

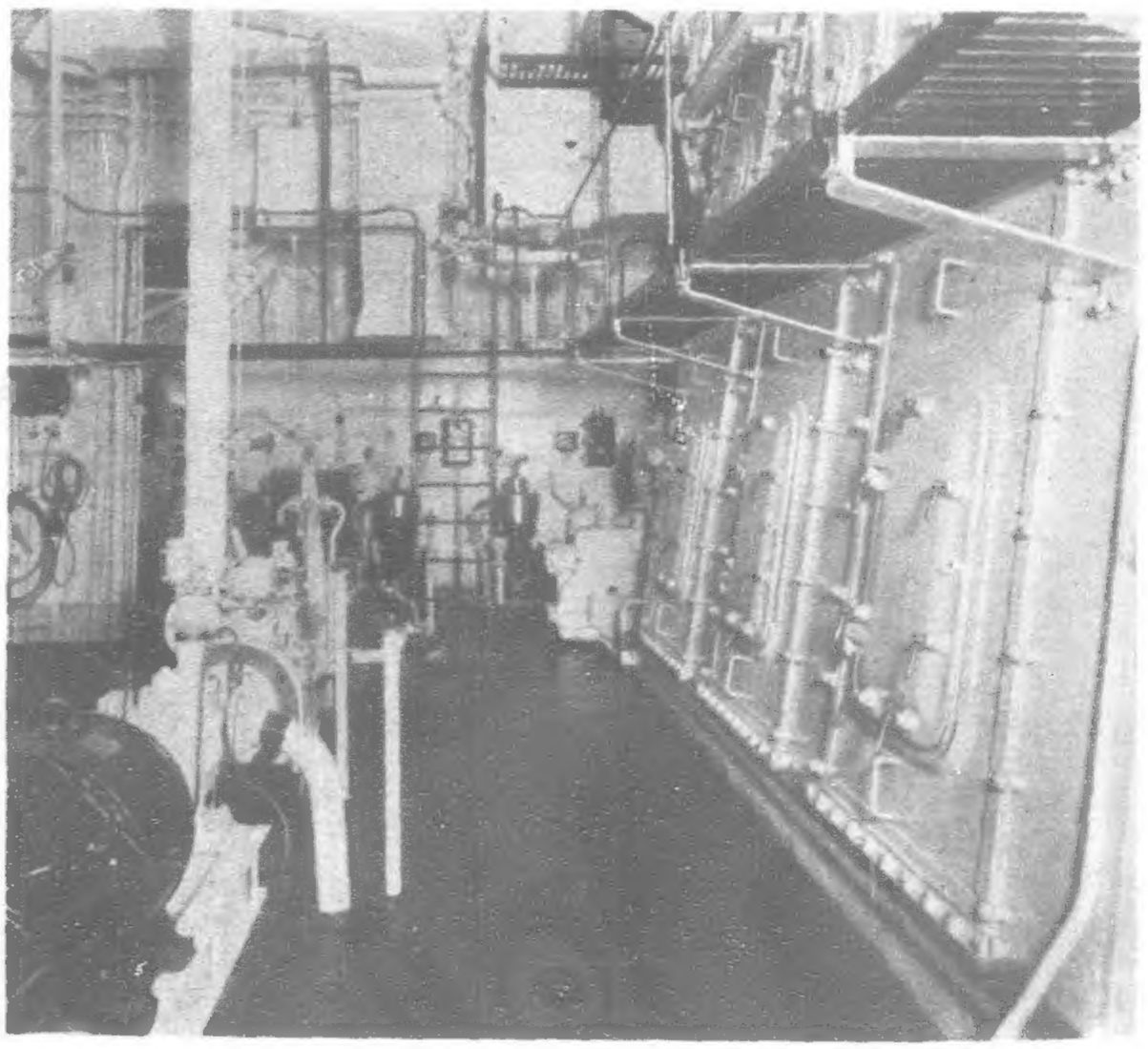
Steering engine—Hele-Shaw type—Kawasaki Dockyard Co.

A mooring winch of Mitsubishi make is also provided on the poop deck.

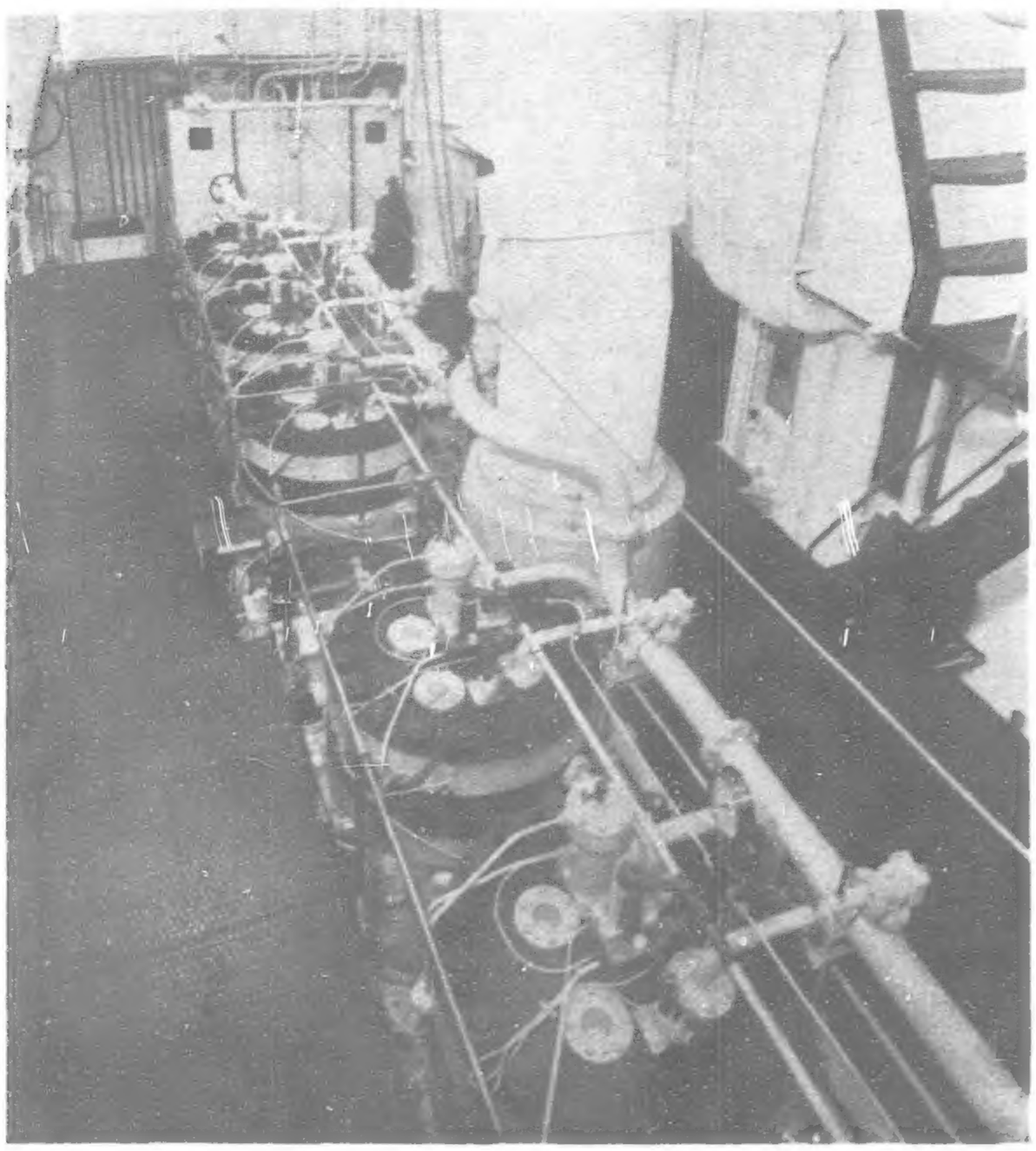
The accommodation and sanitary equipment for the crew have received careful attention, as is usual with the owners.



Showing port side of engine room



Showing starboard side of engine room



Top of main engine of the "Uyo Maru"

Large-sized beds and furniture of good quality have been provided. The dining saloon and the owners' room are beautifully designed and executed with a touch of modernity, and bear a close resemblance to architecture in buildings.

A small refrigerating machine of ammonia type is installed for cooling the refrigerated room for the provision store.

The *Uyo Maru* is the second boat to be completed under the Government "Ship Improvement Act," promulgated in the autumn of 1932.

It is noteworthy that, with the exception of the cargo derricks above referred to, the ship's equipment, fittings, etc., including the main engine and the special Mitsubishi type stream lined rudder, are all of Japanese design and manufacture. In particular, the main engine is exclusively of the builders' own design and construction throughout. A few particulars of it are given below :—

Main engine :—Mitsubishi two cycle single-acting airless injection system, Type 6MS72/125, with six working cylinders of 720 mm. diameter and 1,250 mm. stroke, capable of developing a normal output of 4,200 b.h.p. at 132 r.p.m.

The engine is of similar type to those installed in several vessels constructed by the builders, and in view of the splendid operating results which have been realized over an extended period of time since this type of engine was first built, its low fuel consumption and the complete absence of any troubles, it is receiving high commendation from the owners of the vessels. The following table gives a summary of the sea trials of the *Uyo Maru*.

SHIP NO. 532 M.S. "UYO MARU" SUMMARY OF SEA TRIAL RESULTS

Place		*Off Miye, Nagasaki*	
Date of Trial		September 19, 1933	September 21, 1933
Kind of Trial		Progressive Trial	Full speed Trial
Draught	Fore	2.914 M	2.913 M
	Aft	4.725 M	4.774 M
	Mean	3.820 M	3.844 M
Trim, by the Stern		1.811 M	1.861 M
Displacement (in tons)		6,370	6,383
Weather		Overcast Cloudy with rain at times	Cloudy
Condition of Sea		Rather rough Sea with W'ly Swell	Smooth with S'ly Swell
Direction and force of wind		E. 3 & 4	N. 2
Kind of Load		119%	4/4
Ship Speed (in knots)		16.213	15.788
Slip %		–3.1	–6.4
Engine Speed, R.P.M.		139.8	132.0
Mean Indicated Pressure KG/CM²		6.26	5.57
I. H. P.		5,937	4,986
B. H. P.		4,987	4,155
Dynamo Output, K.W.		46.7	41.6
Power Required for Necessary Auxiliary to Drive Main Engine, kw.	Jacket and Piston Cool, Water Pump	22.5	24.2
	Lubricating Oil Pump	9.3	7.3
	Total	31.8	31.5

Hongkong Fire Equipment

MERRYWEATHER and Sons, of Greenwich, pioneers of motor fire engines and turntable ladders, have just constructed for Hongkong Fire Brigade one of their all-British motor turntable fire escapes. The ladder, in four sections, is constructed entirely of steel, and extends to a height of 100 feet.

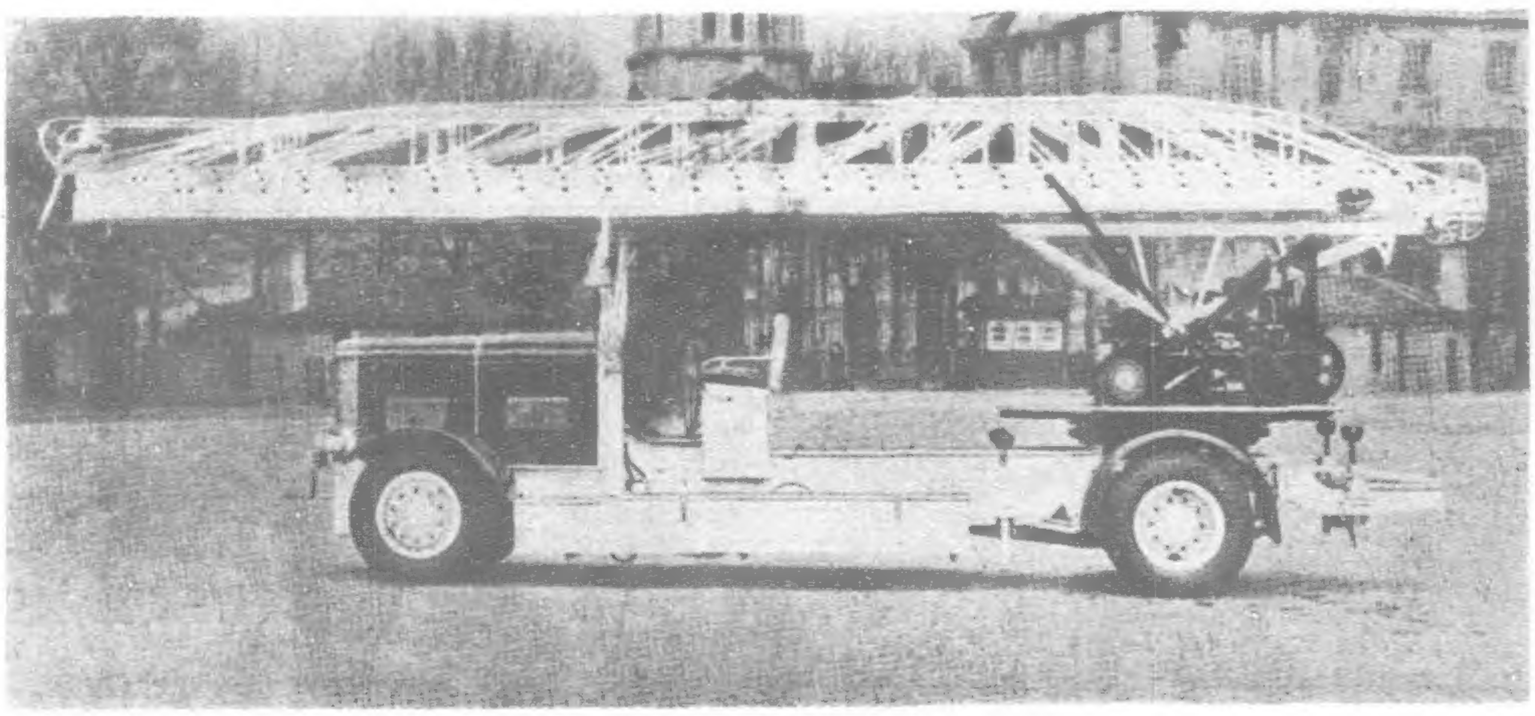
The whole of the movements of the ladder—elevating, rotating, extending, and lowering—are carried out by power from the petrol motor which propels the machine. The ladder can be completely elevated and extended in 25 seconds.

A double-swivelling monitor is fixed to the head of the top ladder for use as a water tower, and a loud-speaker telephone is provided for communication between the ground level and the fireman at the head of the ladder. An 11 inch electric searchlight is provided, which can be used on the machine or from any adjacent point of vantage.

The bodywork of the machine is handsomely finished in white, lined green, and the steel ladder is finished in aluminium, the name Hongkong Fire Brigade being lettered in gold on each side of the main ladder.

The Merryweather chassis is of their latest design, with four-wheel brakes. The petrol motor is of 170 b.h.p., and during the makers' trials the machine ascended Blackheath Hill in top gear at 20 miles per hour.

The machine is entirely of British design, material, and workmanship, and is the first British motor turntable fire escape to be constructed with all-steel ladders.—*Eastern Engineering and Commerce.*



New Merryweather Fire Escape for Hongkong Government

Engineering Notes

INDUSTRIAL

PAPER FACTORY.—The Chinese Government announces that a Shanghai factory, with a capital of $5,000,000 silver, is to be erected for manufacturing newsprint from bamboo. Chinese commercial companies will provide $3,000,000, the Government contributing the remainder.

HONGKONG THREAD FACTORY.—A modern cotton thread factory, equipped with American winding machinery, is now under construction at Cheung Sar Wan, Kowloon, writes a Hongkong correspondent. Production is expected to begin soon. Cotton thread of 90's and 60's count will be manufactured, chiefly for supply to the local hosiery and handkerchief factories. Cotton thread for domestic use will also be reeled on bobbins.

SHIPPING

IMPROVING BANGKOK HARBOR.—The Siamese Government has requested technical advice from experts of the Communications and Transit Organization of the League of Nations concerning the improvement of the means of access and equipment of the harbor of Bangkok. The committee of experts is composed as follows: Mr. A. T. Coode, of Messrs. Coode, Wilson, Mitchell and Vaughan-Lee of London, consulting engineers to the Crown Agents for the Colonies; Mr. G. P. Nijhoff, consulting engineer, former member of the Royal Corps of Waterstaat, Netherlands; Mr. P. H. Watier, Director of Navigable Waterways and Maritime Ports of France. The committee, at a first meeting at Geneva, drew up a list of the supplementary technical and economic data. It also noted as necessary a study of the question on the spot and entrusted that duty to M. Nijhoff, who visits Siam during the month of May.

KOREAN HARBOR IMPROVEMENT.—A recent directors' meeting of the South Manchuria Railway Co. decided to modernize the harbors at Rashin and Seishin, North Korea. Work for the first period will cost Y.20,000,000. The Home Ministry has sent experts to look Rashin over. With the assistance of the Korean Government the railway company already has contracted to purchase land covering 1,000,000 tsubo, on which it will build warehouses, railway stations an sidings. The work during the first period will be complete in 1937, if present plans go through, and the port will be able to handle 3,000,000 tons a year.

COMMUNICATIONS

LONG-DISTANCE TELEPHONY.—The Nanking Minister of Communications is discussing with the Kwangtung Provincial Government a project for a long-distance telephone service to connect Nanking, Shanghai, Canton and Hankow, the principal cities of south and central China. According to the *Chinese Economic Bulletin*, the Canton authorities have intimated their readiness to co-operate.

DEVELOPMENTS IN JAPAN.—One of the largest wireless stations in the Orient, to cost Y.1,000,000 (£100,000 at par), is to be built at Kurume City, according to a decision of the Japanese Government. It will have a power of 100 kw. A television research institute, the first of its kind in Japan, will shortly be completed at Tokyo. It is being built by Waseda University, and will have six studios, in addition to a broadcasting room and a receiving room.

ROAD BUILDING IN MANCHURIA.—The Manchoukuo Bureau of National Highways has drawn up a ten-year program for the construction of 60,000 kilometers of roads. The highways will be divided into first, second and third classes having widths of from eight to eleven meters. The average cost a kilometer is expected to be about Y.1,500. Half of the Y.30,000,000 national foundation loan will be used to pay for the project. It is planned to build 9,000 kilometers of new highways by the end of June, 1936.

MINING

CHINA'S TUNGSTEN DEPOSITS.—The Nanking Ministry of Industry is considering plans to develop tungsten deposits in Kiangsi, the largest producing center of tungsten in the country. It is stated that the outlay will be raised by the issue of loans to be secured on tungsten ores. At least $5,000,000 is considered necessary. China's output of tungsten varies from 50 to 70 per cent of the world's total output.

MALAYAN COLLIERIES'.—The entire plant of the Malayan Wood Distillation, Ltd. (Liquidated), has been purchased by Malayan Collieries, Ltd., and transferred to Batu Arang. This plant is now in course of erection and the products will be charcoal, wood-alcohol, acetate of lime and a wood preservative. Arrangements have been made for the installation of a small commercial-scale plant for the making of roof tiles, and production is to commence during the current year. The production of plywood having reached approximately the capacity of the plant, arrangements have been put in hand for doubling production.